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THE HAUSER LAKE STEEL DAM IN THE MISSOURI RIVER NEAR HELENA, MONT.

The new steel dam across the Missouri River near Helena, Mont., is interesting in itself as a structure and also from the fact that for the greater part of its length it has been successfully founded on a bed of water-bearing gravel. For eight or ten months of the year it will simply impound the water, but it must provide for sudden and heavy floods passing over it. For this reason a timber apron on cribs is built on the downstream side to carry the flood water clear of the main structure before entering the channel. It is about 40 miles below the junction of the three forks of the Missouri River, and 16 miles below the Canyon Ferry timber crib dam of the same company (Engineering News, April 26, 1900). It forms a reservoir which extends to this latter dam, and is known as Hauser Lake. The forebay passes around one side of the steel dam. Directly below the dam is a power house from which current is sent by a high-tension tranmission line to Helena, Butte and the neighboring mining districts. The dam and power plant were built for the Helena Power Transmission Co., the President of which is Mr. S. T. Hauser (ex-governor of Montana); Mr. M. H. Gerry, Jr., M. Am. Soc. C. E., is General Manager, and Mr. Wm. De la Barre, M. Am. Soc. C. E., of Minneapolis, is Consulting Engineer. Mr. James McKittrick was Resident Engineer for the company. The design of the steel dam, including its foundations, was made by Mr. J. F. Jackson, Assoc. M. Am. Soc. C. E., of Houghton, Mich., as Engineer for the Wisconsin Bridge &

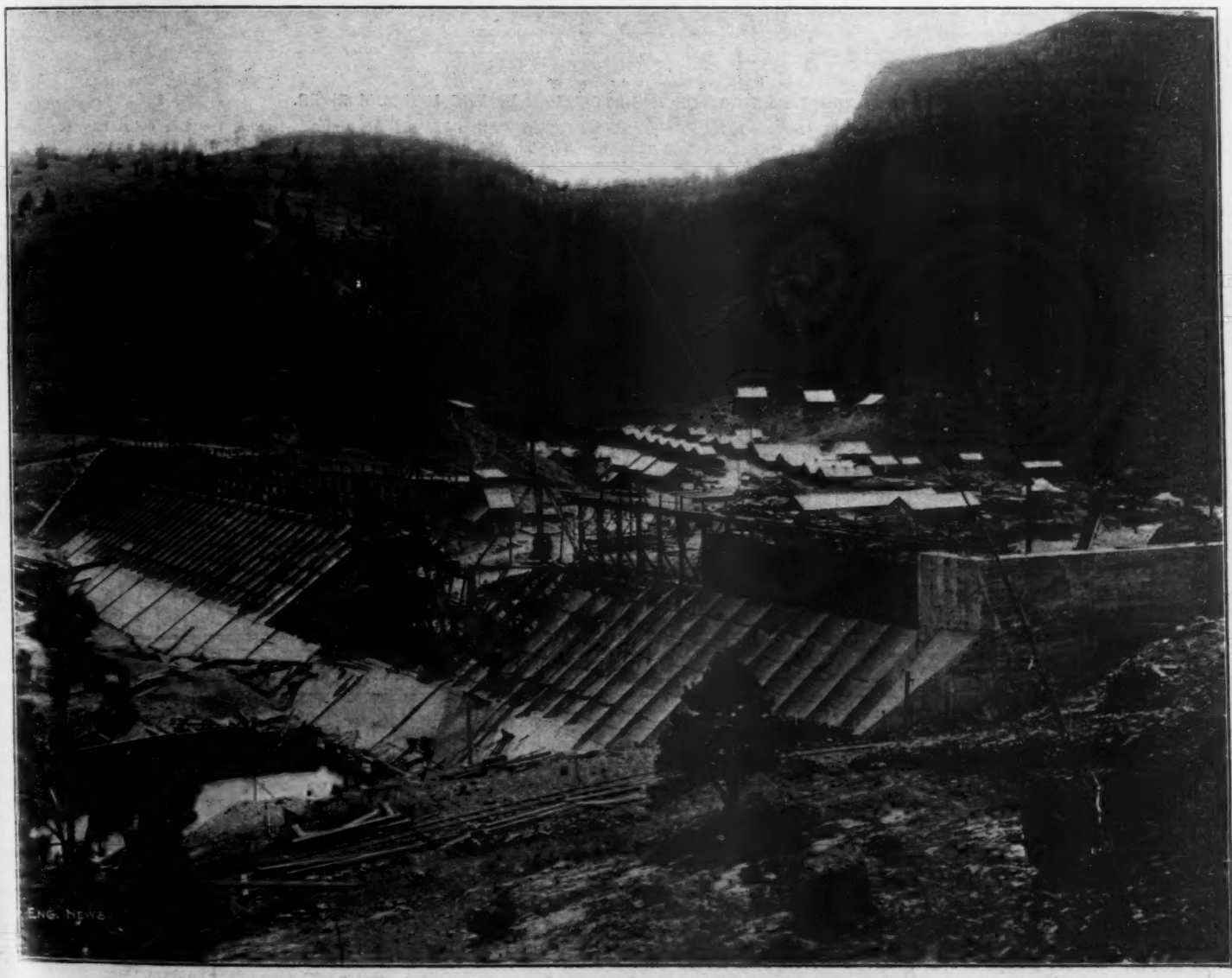


FIG. 1. HAUSER LAKE STEEL DAM IN THE MISSOURI RIVER; HELENA POWER TRANSMISSION CO., HELENA, MONT.
Wisconsin Bridge & Iron Co., Milwaukee, Wis., Builders.

Iron Co., which took the contract for the design and erection. The resident engineers for this company (at different times) were Messrs. V. W. Coddington, Geo. Apple and Fred Smith.

Fig. 1 is a general view of the upstream side of the dam before completion, showing the steel bents, the flat and curved face plates; and the columns to carry the vertical plates, flash boards

the necessary provision against sliding the face has a flat slope of about 1½ on 1, thus utilizing the weight of water on the face for the purpose of stability. A factor of safety of 2 is provided against sliding, while the design of the foundations, etc., provided for a factor of safety of 4 in the steel structure. At the right-hand bank, solid rock extended to Station 23 (10-ft. stations); on

prevent seepage through the gravel, a blanket of fine volcanic ash (found along the river) was laid on the river bed above the dam. This is about 20 ft. deep at the dam and extends upstream on a flat slope for about 300 ft.

The crest is formed by lines of I-beams carrying deck plates, and at each bent is a vertical connection plate projecting sufficiently high to serve

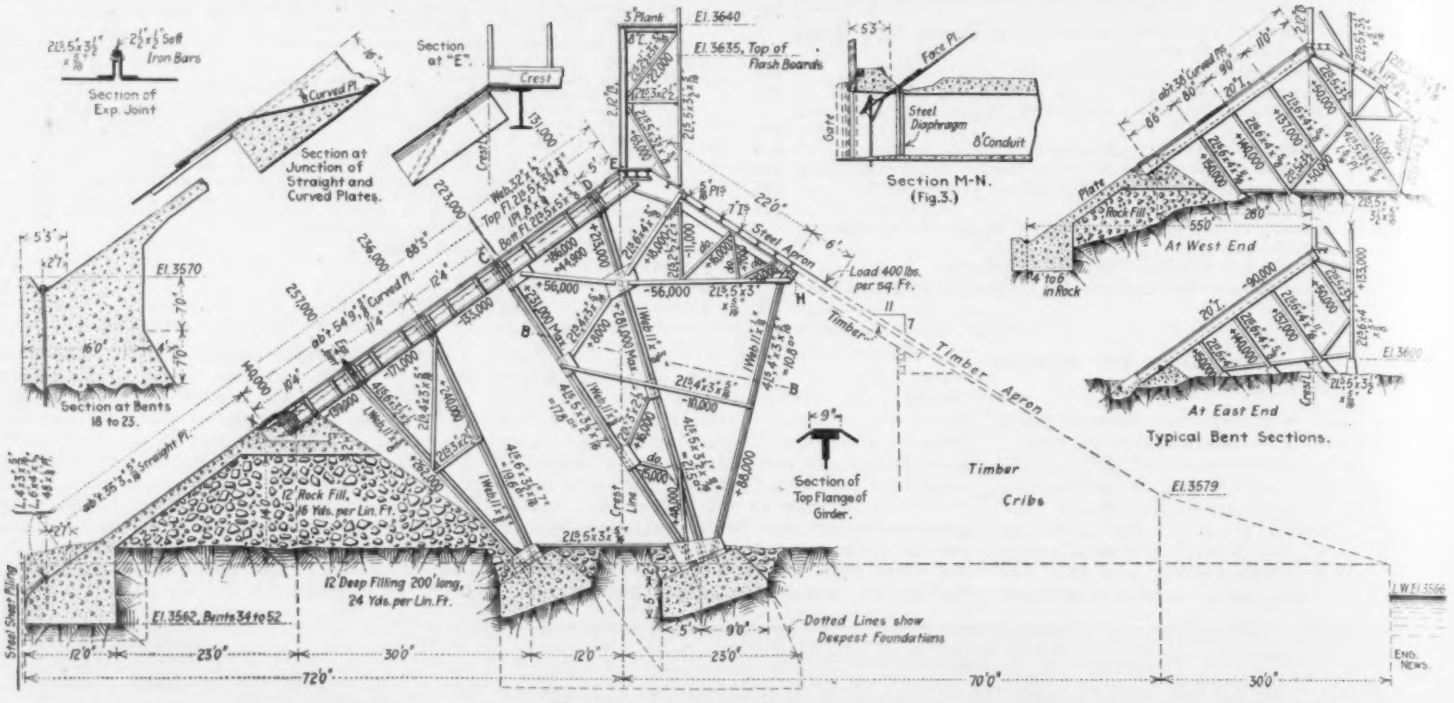


FIG. 2. CROSS-SECTIONS OF THE STEEL DAM IN THE MISSOURI RIVER.

and footbridge. The dark lines on the flat plating are the expansion joints. In the foreground is the channel to the six 8-ft. conduits built to carry the low-water flow (now closed with concrete). The forebay passes around one side, where the railway track is seen, the concrete wing wall of the dam forming one side of the forebay. On the down stream side is the construction camp and through the gap in the dam is seen the concrete mixing plant. At the middle of the dam are two of the electric derrick hoists used in erecting the material.

In general principle the dam resembles those at Ash Fork, Ariz., and Redridge, Mich., (described

the left hand side it extended from Station 53 to the end of the dam at Station 63. The middle portion of about 300 ft. is founded upon a bed of water-bearing gravel of unknown depth.

The character of the foundations is shown in the general cross section, the concrete toe and concrete supports for the steel bents extending the full length of the work. The bents are 10 ft. apart, connected in groups of four by longitudinal bracing, and are composed of built-up members. Each bent carries a 32-in. inclined plate girder to which the face plating is attached. The top and bottom portions of the plating are flat, while the intermediate portion has concave plating. At the

as an attachment for the columns carrying the vertical plates and the flash boards. There are vertical plates in nine bents at one end, while at the same end are ten gates in this vertical portion. This leaves a spillway 500 ft. long and 13 ft. deep. Wooden flash boards are set in the spaces between the intermediate bents when the high-water season is past. The downstream side has an apron of flat plates on longitudinal I-beams resting on inclined plate girders, with a slope of 7 on 11. This connects with a plank apron carried by timbers whose lower ends rest upon stone-filled cribs. These cribs have a plank deck ending with a flat slope whose lower edge is 4 ft. above the

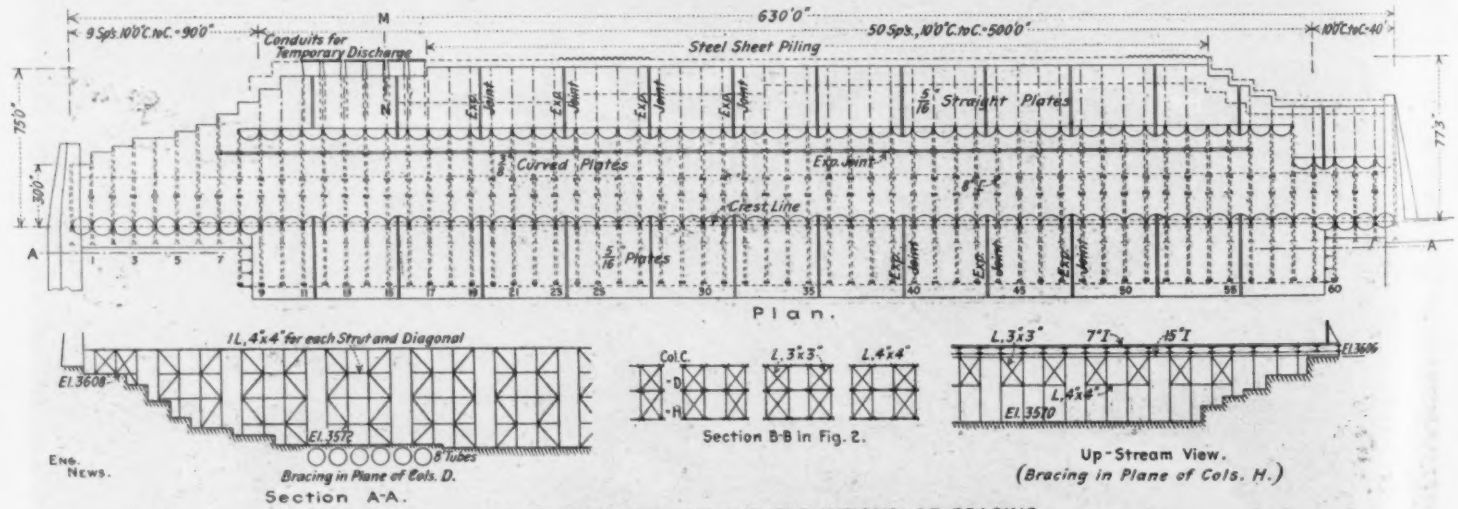


FIG. 3. PLAN OF DAM AND ELEVATIONS OF BRACING.

in Engineering News May 12, 1898, and Aug. 15, 1901). Both of these were also built by the Wisconsin Bridge & Iron Co. Steel bents carry an inclined face of steel plating in all three cases; in the two cases noted above the foundations are on rock and the face has a slope of approximately 45°. In the Missouri River dam, however, the foundations are on gravel, and in order to obtain

foot, there is a curved toe plate riveted to the face plate and to the steel sheet-piling; anchor bolts also connect the face plates to this piling in order to take up some of the tension in the bents. The lower part of the face plating is backed by concrete upon a rock-fill, this concrete being extended to form a toe wall. An upper layer of concrete covers the toe-plate and sheet piling. In order to

normal water level of the river. In this way, any disturbance or undermining due to the action of the falling water will be at a considerable distance below the dam. Any such undermining or any consequent settling of the crib work can easily be repaired during the eight to ten months when no water will pass over the dam.

The details of the bents and the systems of

bracing between them are clearly shown in Figs. 2 and 3. The six 8-ft. tubes are of steel, embedded in concrete, and fitted with wooden gates at the upper end. When the dam was completed, the gates were lowered, and the tubes filled and packed with concrete. The tubes passed through a steel diphragm, to which the toe of the face plating was attached, as shown in one of the details. The maximum height is 81 ft., and the actual head at low water (to top of flash boards) is 69 ft.; the working head is about 66 ft. The plates have lap joints over the bents, and longitudinal butt joints with double-riveted straps. The plating, at the junction of the flat and curved plates, is shown in Fig. 4. The plates were scarfed, beveled and calked as in boiler work, and the riveting was done with pneumatic hammers. The leakage was very slight. The Smith protective coating is used for the facing, and graphite paint for the bents and bracing. The dam contains about 1,700 tons of steel shapes and plates. The material had to be hauled by road for 16 miles from Helena, across a rough country. The steel was handled and erected by means of 5-ton

FIG. 4. A PORTION OF THE FACE OF THE STEEL DAM, SHOWING THE JUNCTION OF THE FLAT AND CURVED PLATES.

derrick hoists built by the contractors; each was operated by an alternating current motor.

The site was selected in August, 1905, and preparation of the general plans was at once commenced. The excavations were made and the foundations built by the power company's forces, which also drove the 35-ft. Friestedt sheet piling forming a cut-off along the toe of the dam. The contract for the dam was made at a price per pound of steel erected. The first work was to build a coffer-dam near the right hand bank, laying bare a strip (mainly solid rock) which was excavated to receive six lines of 8-ft. steel pipe about 100 ft. long, covered with concrete. These served to carry the low-water flow, and were completed early in the winter of 1905. The erection of the steel commenced in November, 1905, but in May, 1906, provision had to be made for spring floods. This was done by building a timber platform to form a temporary spillway, 240 ft. wide, over the partly completed foundations. The flood water was 6 ft. deep over this, in spite of the discharge through the 8-ft. conduits. In July, after the water had subsided, the erection of the steel work was renewed, and this was finished in November, 1906. The dam was put in service in March, 1907, and carried the high-water of the spring floods. The low-water flow for ten months is about 3,000 cu. ft. per sec., but the high-water flow may reach 60,000 cu. ft. per sec.

REPORT OF THE TRANSVAAL COMMISSION ON THE USE OF WINDING ROPES, SAFETY CATCHES AND APPLIANCES IN MINE SHAFTS.

(*Continued from our last issue, page* 494.)

Factor of Safety.

100. The Commission has carefully considered this important matter, and recommends that the present Regulation which provides for a factor of safety of 6 as a minimum during the life of a rope should be adhered to. No reliable statistics were brought forward by any witness, and none were otherwise available, dealing with the working of winding ropes at a lower factor of safety than 6; and the Commission is of the opinion that considerable experience should be obtained with ropes working at lower factors while hoisting mineral, before any departure could be recommended for the Transvaal practice, which has been found to be satisfactory.

101. The breaking of a winding rope while raising or lowering persons happens very rarely, and since mining was re-started on the Rand in 1901 there have only been two such occurrences—this is neglecting an accident which occurred at a mine where 23 persons were killed owing to a rope in good condition being cut in two while lowering the cage, by a projecting bolt in the flange of the drum. Although causing great loss of life—in one accident 44 and in the other 26 persons were killed—it must be recorded that in each of these two cases the rope had been allowed to deteriorate until the factor of safety was far below 6, the persons charged with the responsibility of examining these ropes having failed to detect this. These statistics, as well as others concerning ropes that have been broken when no persons were traveling (see paragraph 143 of this Report), satisfy the Commission that a minimum factor of safety of 6 is sufficient.

102. Mr. E. J. Laschinger in his evidence stated that, considering the great variations to be met with in the design of engine details and in the general arrangement of the winding plant, it should be permissible, especially in deep shafts, to make allowance, in fixing the factor of safety, for special attention paid to the design of the plant which has for its object the ensuring of best working conditions and the safety of persons traveling in the shafts. Mr. W. S. Thomas also favored this idea and agreed that, after a certain critical depth, there was good reason to believe that safety might be assured by the maintenance of a stated reserve of strength in the rope, considering that there were many deteriorating influences, such as shocks due to sudden changes in velocity of winding, which did not increase with depth.

103. Mr. W. A. Kincaid considered that there was additional safety in a long rope, and that for this reason is was not necessary to carry as high a factor as with a short rope—other conditions being the same. There had been cases at the mine he was managing where, owing to the jamming of the conveyance, which involved great resistance to the upward winding, great damage had been done to the timbers; yet the rope did not break, owing, in his opinion, to its being of great length.

104. Other witnesses, especially those acquainted with British colliery practice, advocated factors of safety as high as 10; but there appears to have been some misunderstanding as to whether these were to apply to ropes newly put on, or to ropes that had been some time in service. A careful review of the evidence, however, makes it clear that initial conditions were referred to.

105. The Mining Regulations of The Transvaal, when laying down the minimum factor of safety, deal with the winding rope at work and not when about to be put on the drum; and the Commission is convinced that this is the correct attitude to take up, while recognizing the difficulties that stand in the way of correctly estimating the strength remaining in a worn rope.

106. There has been no suggestion throughout the whole of the inquiry that the mine authorities have ever hesitated, on the grpund of expense or for any other consideration, to discard a winding rope so far as the transport of persons was concerned, when advised professionally to do so. The practice on the Rand is in point of fact quite the reverse of this, and the greatest caution is displayed in this respect to secure the safety of miners. The few errors that have been made have been due to the carelessness or faulty judgment of the persons responsible for the examination of the ropes.

107. In deep-level winding, from 4,000 ft. and over, it is practically impossible to start off with a static factor of safety of more than 7 in the rope. When reduced by wear to a factor of safety of 6, and about to be discarded after possibly no more than six months' work, this rope will still have an enormous reserve of strength, considering static conditions only. Quoting from a paper read before the South African Association of Engineers in March, 1904:

> Imagine for a moment that similar loads of, say, 7 tons each—consisting of 6,000 lbs. conveyance and 8,000 lbs. contents—have to be hoisted from two shafts, one of 1,500 ft. and the other of 6,000 ft. in depth. Supposing the ropes used in these two instances are of the same grade of steel (120 tons per sq. in.), then, if they are compared at a time when they each have the minimum factor of safety of 6, it will be found that the reserve of strength in the case of the 6,000-ft. rope is approximately 2½ times that existing in the 1,500-ft. rope. The latter, when the full skip is at the bottom of the shaft, will be loaded to within, say, 45 tons of its breaking load, while the former retains a margin of about 110 tons.

108. In this paper it was also proved that the shocks due to jerks or sudden changes of velocity were dangerous, practically, only to a short rope; and that after a depth of about 1,500 ft. had been reached, the shock due to any specific change of velocity would remain constant.

109. The Commission was, however, unable to take full advantage of the results of this research and to advise a reduction of the minimum factor of safety for deep-level winding, because it was felt that there were other stresses in the rope that had neither been exactly determined nor proved to be independent of the depth of winding. The stress due to bending is probably the most important of these, and much experimental research is needed to discover how far the flexibility of the rope, and at the same time the bending stress in its wires, is influenced by the closer packing of these which the use of a lower factor of safety would involve.

110. A correct determination of the bending stress in the wires of a rope will be of the greatest value, and, if this can be shown to be much less than it has been assessed by Professor Hrabak and other investigators, there will then be good reason to reconsider the decision now arrived at, viz., that the minimum factor of safety of 6 shall be retained.

111. Evidence was given to the effect that hardship was caused by the present Regulation* which prescribes that, "in case a winding rope is used for other purposes besides the transport of persons, the maximum working load, when raising or lowering persons, shall not exceed 0.85 of the maximum load when the rope is in use for other purposes." In a deep-level shaft, the "maximum working load" consists so largely of the weight of the rope itself that when the above-mentioned rule is applied, it is found that an unnecessarily small number of persons may be carried in a conveyance of ample dimensions to accommodate more. The Commission agrees with this contention, and recommends that this Regulation be amended so as to make the limiting ratio—1 to 0.85—apply to the relation between the weight of conveyance and mineral contents to the weight of conveyance and persons.

The Best Method of Attaching the Rope to the Load.

112. The method of making this attachment, commonly called the capping of the rope, is a matter that merits close attention and has, during the last few years, been the subject of many contributions to the engineering societies and the scientific press of Great Britain. The ideal capping should be at least as strong as the rope; it should be easily accessible for examination of the interior and should be easy to make.

*Article No. 40 (i).

113. From the evidence brought before the Commission, there appears to be great diversity of opinion as to whether a splice, coned socket, split socket or clips is the most satisfactory attachement. All of these methods have their disadvantages. Some cappings are open to the objection that they screen off an important part of the rope from examination. With few exceptions, their efficiencies are very low as compared with the strength of the rope. Experiments have been made from time to time, both in England and other places, to determine their respective efficiencies by means of test.

The Transvaal Mines Department has also made a special series of tests of the different methods of attachments in use on the Witwatersrand mines. The results, together with sketches, are appended to this Report, from which it will be seen that these vary from 71% up to 100% efficiency. The most variable results are obtained from the conical socket, in which the wires of the rope are opened out and turned back to form a cone which more or less fits the interior of the socket, the interstices being run up with some suitable white metal.

114. In the experiments with eight conical sockets, the lowest efficiency obtained was 71.12%; while in three cases the rope itself broke quite clear of the attachment. A good deal of the variation is doubtless due to the difficulty of running in the metal in such a manner that it forms a solid cone with the wires. In some cases it is little more than so much packing, the result being that the strain comes on the wires that are bent around at the base of the socket, and this invariably makes them break at that point.

Recently, in South Wales, a Rope Caps Committee conducted a number of tests of this conical socket, and obtained efficiencies varying from 35.3% to 76.5% and averaging 56.9% for six cappings. The Committee reported that: "The direct cause of giving way in all cases was the rupture of the wires at the place where they are doubled back to form the cone, and this appears to be the weakest point in our present method of capping."

115. If it is necessary, owing to the want of head room, to use this class of capping which has the advantage of being very short, the best way to make it up is to leave the wires straight, and to clean and tin them before drawing down the socket over them. The next step is to pour in a white metal the melting point of which is less than 500° F., as is done in public testhouses.

116. Splices are very satisfactory, both as regards their efficiency and the ease with which they can be examined, but it requires a skilled artisan to make them in a satisfactory manner. Unless a mine is sufficiently large to find constant employment for such a man, this method of capping presents difficulties.

117. Probably the most satisfactory method of attachment, where there is sufficient distance between the pithead sheave and the point where the skip or cage is unloaded, is to use clips of an approved pattern. From experiments made, it is found that a clip of the Crosby type, which provides a good bearing surface, is to be preferred to others where the bearing area is little more than a series of points, and which, to get any grip on the rope, must damage it locally. The clips should be sufficient in number, say five in the case of a rope of 1⅛-in. diameter, and spaced 1 ft. apart. The lowest clip should be quite close to the pear-shaped thimble or eye.

118. It is obviously a very simple matter to connect a rope to the load in this way, and the exterior of the rope is easily accessible for examination. This capping has also the advantage of a high efficiency—about 90%.

119. There appears to be no doubt that safety chains are an advantage on a man-cage or skip, and are recommended; and these, as well as all other attachments, should be made either of the best mild steel or the very best brand of iron (Lowmoor, Swedish Charcoal, etc.). If made of iron, these attachments should be annealed at regular intervals.

The factor of safety should be at least as high as, and preferably higher than, that borne by the rope, on account of the shocks to which such attachments are subjected, which in time have a tendency to make the iron or steel brittle. For this reason, iron is to be preferred to steel for this service, as the annealing of the former is far more likely to be efficiently carried out.

The Commission does not recommend the use of a swivel connection between the rope and the load, except in the case of sinking, where an unguided conveyance, such as a kibble, is used for hoisting. A swivel has the effect of untwisting the rope and making the wires slack. It may be an advantage to let out of the rope that tendency to untwist which is due to the stretching effect of the load. In such a case, disconnect the load at the bottom of the shaft once or twice, soon after a new rope has been put to work, and connect up again after the rope has stopped spinning.

120. A spring connection would probably minimize the shock on the rope where short ropes are used, but its use is not necessary in the case of a deep shaft on account of the great elasticity in the rope itself. If it is intended to fit any spring relief, the most practical method of doing this is to have the springs arranged in a frame under the plummer blocks that carry the pithead sheaves. The blocks must be allowed to move only in synchronism, and not independently, as the latter would tilt the axle and sheave.

The Reliability and Adaptability of Safety Catches and Appliances in Shafts.

SPEED CONTROL.

121. For controlling the speed of winding and for generally securing smooth running, the use of a properly adjusted governor and a recording tachometer is recommended. The control of the steam throttle-valve should not be taken out of the engine-driver's hands by any automatic device, unless such device be fitted so as only to come into action to prevent an overwind. The governor should operate on the cut-off mechanism, and thus prevent over-speeeding at any period of the winding.

122. The recording tachometer will give a permanent record of all trips made and the speed at which the winding was done. While it exerts only a moral influence to prevent accidents, still, should an accident occur, it will prove a great service in supplying a reliable impersonal record of the speed of winding at the time, and the behavior of the engine.

OVERWINDING PREVENTION DEVICES; SAFETY HOOKS.

123. With respect to the prevention of the overwinding of the conveyance, the necessity for some device to effect this prevention will be apparent when one considers the number of accidents that occur, and also the loss of life and damage done to the winding plant, due to this cause.

ACCIDENTS DUE TO OVERWINDS.

124. The following are the statistics of "overwinds" that occurred during the 2½ years ended December 31, 1906:

Total number of accidents 67, of which 9 were fatal.	
Cases in which overwinding hooks were fitted (3 successful; 2 not brought into action owing to jamming of conveyance in headgear).	5
Cases in which "visors" were fitted. (Unsuccessful; driver had reversing lever the wrong way).	1
Cases in which no overwinding hooks or "visors" were fitted	61
Total	67
Cases in which an overwinding hook would have prevented the cage from going to the bottom of the shaft after rope fracture, and probably saved life	5
Cases in which an overwinding hook would have prevented the cage from going to the bottom of the shaft after rope fracture, and probably prevented damage to property	40
*Cases in which overwinding hooks could not have been fitted, or would have been useless	22
Total	67
†Cases in which the engine-driver overwound, due to his own neglect	56
Cases in which the engine-driver overwound, due to other causes	11
Total	67
Cases in which overwinds caused fatal accidents at the bottom of the shaft	8
Cases in which the engine-driver had his reversing lever in the wrong direction, and thus caused an overwind	13

125. Since the beginning of the present year, 1907, there have been three cases of overwinding in which the detaching hook acted successfully. The suspending of the cage after the rope was freed was effected by safety catches, the wings of the hook not being required for this purpose. In two of these cases, persons were traveling and were saved from serious injury. Three safety hooks were officially tested and were quite successful in their action.

126. The Commission reports unhesitatingly in favor of detaching hooks for winding in vertical shafts, with the limitation that, where rests are used for loading in very deep shafts, the heavy hook is a possible source of danger—the length and weight of rope hanging in the shaft making it difficult for the engine-driver to control the amount of slack given out, thus leading to the chance of the hook bumping on the top of the cage.

The detaching hook is not recommended for use in inclined or compound shafts where pulleys are used for the rope to run over; as there may be a danger of the hook, of whatever design, striking such pulley and coming into premature action.

127. The extent to which safety hooks and overwinding-prevention devices are used in the Transvaal is set forth below, together with the opinions of the mine managers regarding their efficiency.

AUTOMATIC DEVICES TO PREVENT OVERWINDING.

128. The following table summarizes the information furnished to the Commission in regard to the use in the Transvaal of automatic devices to prevent overwinding:

	Gold mines.	Coal mines.
With safety devices	7	2
Without safety devices	117	7
Tested with satisfactory results	6	1
Tested with unsatisfactory results	0	0
Operated successfully	2	1
Operated unsuccessfully	0	0

129. The 7 gold mines have 9 automatic devices to prevent overwinding, and, of these, 6 are reported as being perfectly satisfactory; the remaining 3 are unsatisfactory, and the reasons given therefor are that they detract from the proper working of the depth indicator, and if called into action the sudden shock is likely to damage the winding plant seriously.

130. Eight of the above devices act on the steam supply to the winding engines, as well as on the brakes; the remaining one acts on the brakes only.

131. The methods in which these devices operate are as follows:

Four speed safety devices are operated from a Bertram visor gear acting in conjunction with the depth indicator; one is operated through the depth indicator and also by hand from the engine-driver's platform; one is brought into action by the drag-link on the crank-pin, and also by a knocker-device in the headgear in case the engine-driver starts the engine in the wrong direction; and three are operated through the depth indicator only.

132. In the case where the overwinding device is operated by means of the depth indicator, if the latter goes wrong an overwind is not likely to be prevented. This has been the cause of some accidents locally, so that it is considered that the overwinding-prevention device should act quite independently of the depth indicator.

ROPE-DETACHING HOOKS.

133. The following table shows the number of gold and coal mines in the Transvaal where safety hooks are in use:

	Gold mines.	Coal mines.
With safety hooks	13	13
Without safety hooks	111	10
Tested with satisfactory results	7	10
Tested with unsatisfactory results	0	0
Operated successfully	6	8
Operated unsuccessfully	0	0

134. On three gold mines where no safety hooks or overwinding-prevention devices are in use, two have loops provided in the headgear into which the wheels of the skips will run and so prevent the skip falling in the event of the rope breaking owing to an overwind. The third has converging guides so that the skip will be held fast in these in the event of an overwind.

135. The Commission has not had the opportunity to test any of the speed safeties or other overwinding-prevention devices, and is not in favor of making their use compulsory.

This corresponds with the recommendation of the Dortmund Commission in 1903, in which mining district there are many speed safeties of various patterns at work, none of which were considered sufficiently reliable to recommend definitely.

136. Converging guides, buffer beams, safety keps or catch beams are not made use of to any great extent in the headgears of the Transvaal mines; but their use is recommended, not compulsorily, in those comparatively few cases where the tipping arrangements of the skips will allow of their being fitted.

137. The present Regulation* which provides for a reduction in speed on nearing the surface, in cases where no automatic overwinding-prevention devices are installed, is doubtless of some service in preventing accidents; but there appears to be something more necessary.

138. In 2½ years, out of a total number of 67 overwinds, 56 were due to the engine-driver's neglect; and of this number 13 were caused through the engine-driver having his reversing lever in the wrong direction. The majority of these drivers were certificated and there no question arose as to their competency. From the annual reports of the Government Mining Engineer, it will be seen that the Inspectors of Mines have not hesitated to apply Article 154, which provides for the suspension of certificate in case of gross inattention or negligence; and it can only be hoped that a continuance of this practice will in time bring about the desired result.

A contrivance attached to the reversing gear, to prevent the engine being started in the wrong direction, would be of service; but the Commission is not in a position to recommend the compulsory use of such a device, as its reliability must first be thoroughly established by practical trials.

ACCIDENTS DUE TO RUNAWAYS.

139. In the period above referred to, the following accidents were due to "runaways" of skip or cage:

Total number of accidents 31, of which 8 were fatal.	
Accidents due to neglect of engine-driver	15
Accidents due to other causes	16
Total	31
Accidents due to clutch breaking or coming out of gear	5
Accidents due to other causes	26
Total	31

*Article 40 (g)—to be published here later.

*These cases consist of such accidents as when the engine-driver overwound on the down trip, overwinding on inclined shafts, skips jamming in the tips, etc.

†These accidents were caused by the main steam valves breaking, indicators slipping, wrong signals, other persons interfering with engine, brakes not acting, shoe in reversing link stuck, engine running out of control.

140. These accidents were due to clutches breaking or coming out of gear, brakes failing to act, pinion of spur-gearing breaking, or unauthorized persons tampering with engine.

141. Two accidents, in addition to those stated above, were caused by the rope slipping on sheaves of Whiting hoists.

142. Of the 15 accidents due to the neglect of the engine driver, the most general cause was the unclutching of a drum which was either not braked or insufficiently so.

(To be Continued.)

NEW WATER SUPPLY TUNNELS AT CHICAGO.

The city of Chicago takes its water supply from Lake Michigan by means of a number of tunnels extending under the bed of the lake and terminating in five intake shafts surmounted by protecting cribs. Extensions of these tunnels under the city lead to the various pumping stations, while other tunnels connect these stations in such a way as to permit of flexibility in distributing the water to different parts of the city. The system of tunnels and intakes was described and illustrated in our issues of Oct. 18 and Nov. 8, 1900; the latest intake tunnel and crib were described in our issue of Aug. 31, 1899. An important addition to this system is now being constructed for the purpose of improving the water supply of the southern portion of the city. This consists of a new 14-ft. intake tunnel 2.3 miles long, extending to a new intake crib, and connecting with 7.45 miles of 12-ft. and 9-ft.tunnels under the city. All these are of horseshoe section, and lined with concrete. The combined length will be about ten miles. The contracts aggregate nearly $3,000,000, and call for the completion of the work by the end of 1908. These tunnels form what is termed the Southwest tunnel system, and will serve three pumping stations, each having a capacity of 100,000,000 gals. per day. Still another lake tunnel is projected, as noted below, in connection with the Blue Island Ave. land tunnel.

It may be noted that Mr. Walter A. Shaw, Engineer in Charge of the Bureau of Engineering (now resigned), states in his report for 1906 that in the general improvement of the city's water supply system all tunnels and pumping stations are being so located and constructed that finally all the stations will be of 100,000,000 gals. daily capacity and will be about six miles apart. This will make it necessary to force the water through the pipes for only about three miles, thus greatly improving the pressure and effecting a saving in the cost of pumping on account of the low friction heads in the water mains. The total amount pumped during the year 1906 was 159,488,382,740 gals. against an average head of 108.38 ft. This represented an average of 204 gals. daily per capita for a population of 2,140,000. Mr. John Ericson, M. Am. Soc. C. E., is City Engineer; Mr. J. H. Spengler, Assistant City Engineer, and Mr. W. S. MacHarg, Consulting Engineer. Mr. George F. Samuel is Engineer in Charge for the city.

NEW SOUTHWEST LAKE AND LAND TUNNELS.

INTAKE TUNNEL.—The new lake or intake tunnel, now under construction, will extend in a straight line approximately northeast under the lake from a shaft near the foot of 73d St. to an intake shaft and crib near that of the present 7-ft. tunnel from 68th St. It will have a flow capacity of 300,000,000 gals. per day. From the shore shaft the tunnel will run under 73d St. to Yates Ave. (2,000 ft.) to connect with the land tunnels described further on. It will be about 12,180 ft. long, and will have its center line 123 ft. below the water level (city datum). This is deeper than any of the older tunnels, but will (it is expected) put the work in solid rock throughout. In this way it will be free from the numerous troubles encountered from bad material, water, etc., in the earlier works, as described in the articles above mentioned. The borings show rock at depths increasing from 58 ft. at the shore shaft to 103 ft. at the intake shaft. Above it are beds of clay of varying character, but with a hard clay immediately above the rock. West from the shore shaft the grade of the tunnel will rise so that at the Yates Ave. connection the center line will be 90 ft. below datum.

The tunnel is of horseshoe section, 13 ft. 8 ins. wide at the springing line and 14 ft. high; the roof has a radius of 6 ft. 10 ins., while the sides and invert have radii of 14 ft. It will have a lining of 12 ins. of concrete made in proportions of 1:3:6. There will be a permanent shaft at the shore end, two intake shafts 32 ft. c. to c. in the intake crib, and a temporary working shaft and crib about 5,000 ft. from the intake end. All the shafts will be 14 ft. in diameter. There will be an angle in the tunnel. This was to have been made at the shore shaft, but for construction reasons it will be at the intermediate shaft instead. The tunnel and shafts are shown in Fig. 2. In regard to the size of the tunnel excavation, the specifications provide that this must conform as nearly as possible to a neat line 17 ins. outside of the inner face of the tunnel. No projections within this line must exceed 5 ins., so as to maintain a minimum thickness of 12 ins. for the concrete lining. The projections that will be allowed within the outer neat line will be determined at intervals of 5 ft. The sum of the base areas of all such projections in any 5-ft. length of tunnel must not exceed 15% of the total area formed by multiplying the length of the outer neat line by 5 ft. The base areas will be measured on this neat line.

The intake crib will be circular in form, 114 ft. diameter at the bottom of the lake, and 109 ft. 1¾ ins. at the top; it will be 46 ft. 4 ins. high, with the top 13 ft. 4 ins. above water. Upon this will be built a house or superstructure. The lower 25 ft. of the crib will be of timber, the bottom being formed by a solid grillage 4 ft. 4 ins. thick. Above this the crib will be cylindrical with a 60-ft. well. Two pairs of steel trusses crossing the well (the pairs intersecting at right angles) will be built into the crib to stiffen the bottom and walls while launching and sinking. In the timber sides will be eight intake ports 7 × 7 ft. The timber part of the crib will be sheathed on both sides with 3¾-in. yellow-pine planking. Above this will be the steel portion, 14 ft. 6 ins. high, consisting of two concentric shells of ½-in. plate, 60 ft. and 110 ft. 6 ins. diameter. Each shell is four rings in height. Between the shells will be 24 radial diaphragms of ⅜-in. plate, forming pockets or compartments. Rip-rap stone not over 12 ins. in size will be placed in these compartments as ballast in the launching and sinking of the crib. This will be removed, however, when the crib is in place, and will be deposited around the base of the crib, the pockets or compartments being then permanently filled with concrete. The upper 7 ft. 6 ins. of the crib will be of masonry, having an inner and outer facing of granite and a backing of concrete.

Through the bottom of the 60-ft well will pass the two 14-ft. intake shafts, the upper part of each having a cast iron lining, with six gates and gate hoisting gear. The gates have openings 5 × 6½ ft., and are at two levels; the three lower ones are 6 ft. clear above the bottom of the well and the others about 15 ft. above it. The top of each shaft is 8.5 ft. above the water line. The temporary crib is of timber, with rock filling. It is hexagonal in plan, 76 ft. over opposite sides. Through the central well rises the 14-ft. steel shaft, lined with 18 ins. of brick. The top of both the crib and the shaft are 12 ft. above the water line.

The contract for this lake or intake tunnel, including the shafts and cribs was awarded on Feb. 19, 1907, to the George W. Jackson Co., of Chicago, at $1,579,890. By the middle of August the shore shaft had been sunk into the rock (a depth of 65 ft.) the intermediate crib had been placed, and the steel towers erected for the aerial rope tramway to this crib. The work is to be completed by Dec. 31, 1908. The intake will be known as the Edward F. Dunne crib, being named after ex-Mayor Dunne.

At the location of the shore shaft there is a surface stratum of loose gravel with boulders and pockets of running sand. Below this there is hard clay, extending to the rock. In order to pass through the bad material, it was decided to form a 21-ft. shell or caisson of steel piling (extending into the clay) before commencing the work of excavation. The piling is of the Jackson interlocking type, in which alternate piles are 12-in. I-beams, while the others are pairs of 12-in. channels riveted together. The channels are placed with the flanges inwards, but far enough apart to admit the web of the adjacent I-beams. A circular wooden template was erected as a guide in setting the piles, and the I-beam piles were bent in the web so as to give the required diameter of the shell. The shell is stiffened by eight outside ribs, each consisting of a 12-in. I-beam having its flange riveted against the web of one of the I-beam sheet piles; these ribs also served to hold the work in line while driving. Fig. 3 is a view of the completed lining, ready for excavation. The piles are in 50-ft. lengths, and were driven with a 5,000-lb. steam hammer. After a complete ring had been formed with piles driven about 12 ft., those at one side were driven to the full depth, the pile driver being then pushed forward into the circle to complete the driving from the inside. A water jet was used occasionally, and in some cases the driving was very hard on account of the boulders in the gravel; some of the piles required over 100 blows for 12 ins. of penetration. The hollow spaces in the channel piles were filled with sawdust to make the shell watertight. After the interior core had been excavated, a concrete lining was put in to protect the steel. Below the sheet piling, the shaft is lined (through the clay) with a steel shell in rings 9 ft. high, each ring of slighly less diameter than the one above and lapping inside the latter. The shaft is now down 65 ft., and has entered the solid rock.

Steel sheet piling will be used in putting down the intermediate working or temporary shaft. At this latter shaft, the steel piles will be 52 ft. long, forming a shell 16 ft. diameter inside, with the top 11 ft. above the water level. Inside of this will be another shell of 20-ft. piling, 11 ft. 5 ins. diameter, the space between the shells being packed with clay.

The material excavated at the headings from the intermediate shaft will be handled in an interesting manner by means of a wire rope tramway extending from the shore to the temporary crib, about 1½ miles. This tramway has 26 steel towers in the lake, 300 ft. c. to c., and 35 ft. high above the water. This is shown in Fig. 4, in which the present crib is visible on the horizon. The foundation of each tower consists of four steel piles of L section, forming the corners of a 12-ft. square. These piles vary in length from 22 ft. at the shore end to 49 ft. at the crib end, the depth of water varying from 9 to 34 ft. In all cases these piles or pedestals extend 5 ft. above the water, and are connected by horizontal bracing. The towers were built at the contractor's structural steel shops. Parallel with the tramway are lines of steel piles, one pile opposite each tower. These are to anchor guys to prevent swaying of a pipe line carried in the towers. The stationary cable will carry buckets of 12 cu. ft. capacity (1,200 lbs. of loose rock), spaced 300 to 350 ft. apart. Passenger cars will be used to carry the men to and from work. The hauling cable will run at a speed of 450 ft. per minute, the cars making the trip in about 17 minutes. The tunnel cars, shaft hoists, cable tramway, air compressors, repair-shop tools, etc., will all be operated by electricity from a large power station at the foot of 73d St., where a very completely equipped repair shop has also been established. The plant will represent about 1,000 HP. A 4,000-volt current is taken from the mains of the Chicago Edison Co. and transformed to 440 volts. The rock from the tunnel will be crushed, and used in making concrete for this and other work which the company has in hand.

LAND TUNNELS'—The land tunnel forming an extension of the intake tunnel above described is in two sections. The first runs west under 73d St. to State St.; the other runs south under State St. to a point between 104th and 105th Sts., where it turns west to the pumping station on Stewart Ave. They are 12-ft. and

9-ft. horseshoe tunnels, with concrete lining, as shown in Fig. 5. The clear inside dimensions are as follows:

	12-ft. tunnel ft.	ins.	9-ft. tunnel ft.	ins.
Width at springing.....	11	8	8	8
Tctal height	12	0	9	0
Radius: Crown	5	10	4	4
Radius: Sides and invert.	12	0	9	0

The 73d St. tunnel will be a 12-ft. tunnel 16,640 ft. long, with 800 ft. of 14-ft. tunnel at the lake end, to connect with the intake tunnel. It will have three 9-ft. branches of 700 ft. each, extending north in State St., west in 73d St., and south in Yates Ave. The west extension will end at a gate shaft from which a tunnel will be built later to a pumping station at Western Ave. and 75th St. The contract was let on July 12, 1906, to the Parker-Washington Co., of Chicago, at $800,225, and calls for the completion of the work by Oct. 1, 1908. The work is in charge of Mr. C. Larkin, Chief Engineer for the company. Up to the middle of August, 1907, about 8,463 ft. had been excavated, and 296 ft. lined with concrete. Work is in progress at eight headings from four shafts, and the advance averages 50 ft. per day. The rock is a hard limestone. Very few caves occur, and the excavation is kept fairly close to the neat line. Fig. 6 shows the work in progress, and Fig 7 is a view of a completed section. The engineers for the city take cross sections at frequent intervals with a "sunflower" instrument, and these are plotted on diagrams showing the tunnel outline. The contractors check these occasionally. For this purpose a jointed telescopic horizontal rod is used, with a disk at the middle graduated for angles. A graduated rod is placed radially at different positions, the disk showing the angle of the rod and the rod showing the clear distance. Small projections within the neat line are blasted with light charges in holes made with pneumatic plug drills.

Each shaft has a 200-HP. steam plant with hoisting engine, air compressor, electric light unit, and an exhaust fan to draw off the smoke and gases after the blasts. The plants are very compactly arranged, and are composed of machinery which can be used in various kinds of work, so that the investment for special plant is small. A stiff-leg derrick serves the shaft. The hoisting cable passes under a sheave on the cage and is made fast at the head of the shaft. The tunnel cars are hauled by mules, and from the top of the shaft they are run to an end-dumping platform, depositing their contents in a larger side-dump car, which is hauled up the dump by a cable. This avoids all liability of the wet stone freezing in the tunnel cars, which might occur if these were hauled out to the dump. At two of the shafts are crushing and screening plants, the stone being used by the contractors for the concrete tunnel lining and for concrete for street and other work for which they have contracts. One of these plants is shown in Fig. 8. The lagging for the concrete lining is of pine, 2½ × 6 ins., in 16-ft. lengths. This is supported on ribs of steel angles 4 × 4 ins., spaced 4 ft. c. to c. Each rib has two angles forming a horseshoe when put together, and a horizontal 6-in. channel is bolted across these at the center to strengthen the rib and also to form a support for a scaffolding or working platform from which the concrete is delivered and rammed. The key of the arch is built in 4-ft. sections, with lagging spanning between two ribs. This is shown in Fig. 9, which also shows an unusually large hole above the roof line. The work is carried on in three 8-hour shifts. In concreting, one gang puts in the floor, another puts in the sides and the third puts in the roof and key.

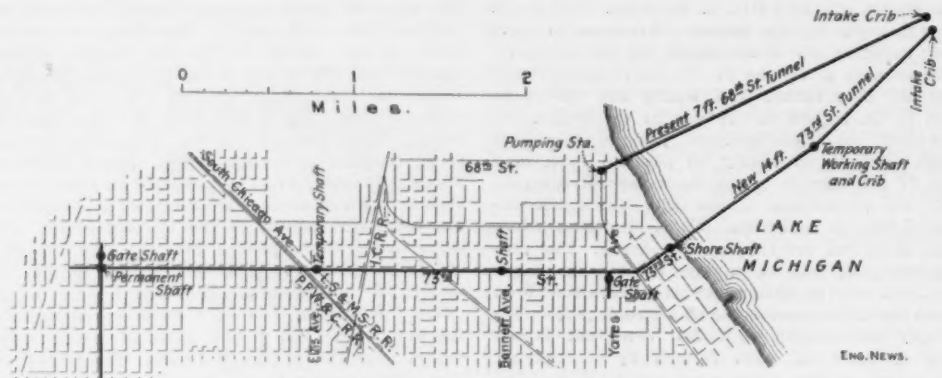
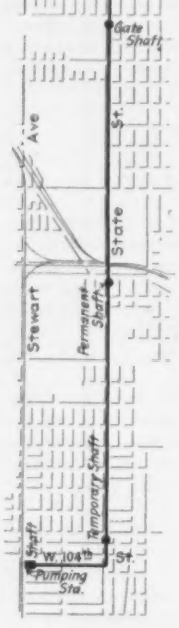


FIG. 1. MAP OF NEW SOUTHWEST LAKE AND LAND TUNNELS FOR THE WATER SUPPLY SYSTEM OF CHICAGO.



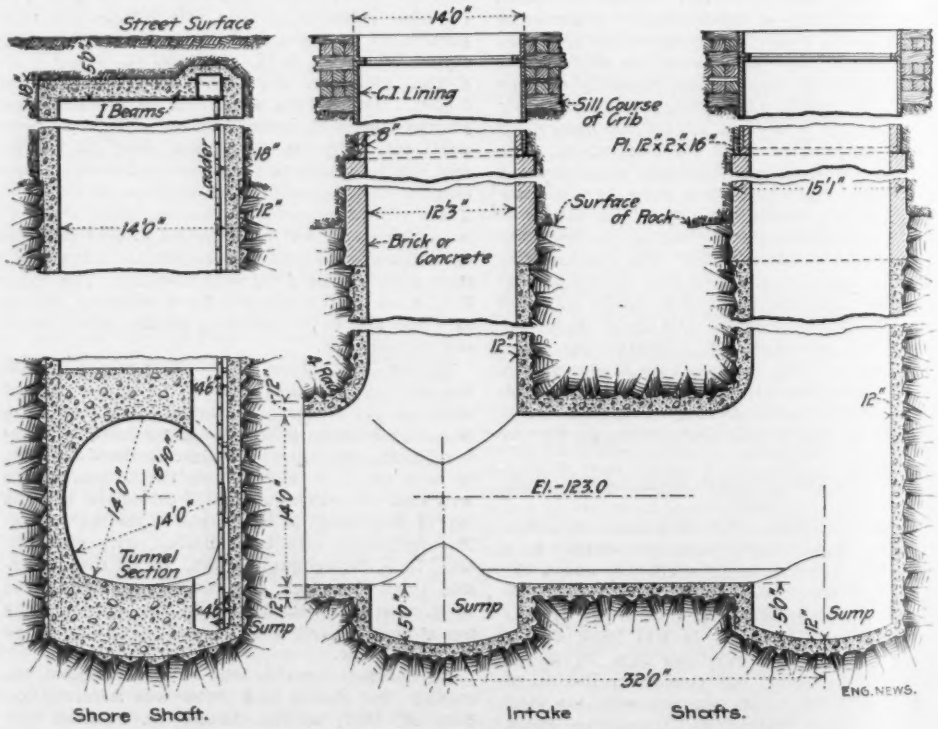


FIG. 2. INTAKE TUNNEL, WITH SHORE AND INTAKE SHAFTS.

Two alternative plans were covered by the specifications. The first (which is the one adopted) is to carry the tunnel through rock as a direct extension of the lake tunnel, the center line being 90 ft. below datum. The alternative plan was to carry about 12,300 ft. of tunnel east from State St. above the rock, or 33 ft. below datum. In such case this portion of the tunnel would have been circular in section, 12 ft. diameter, with four rings of brick or 12 ins. of concrete lining. The connections with the deeper portions of the tunnel at each end would, of course, have been made by the shafts.

The State St. tunnel will be of the 9-ft. horseshoe section (Fig. 5). It will be entirely in rock, with its center line 90 ft. below datum. It will be 22,700 ft. long. The contract was let on April 9, 1906, to Joseph Hanreddy, at $611,590. The work is to be completed by Oct. 1, 1908. Up to the middle of August, 1907, about 4,065 ft. had been excavated, and 502 ft. lined with concrete. The shafts are operated on the head-house system. At the 75th St. shaft, the material is hoisted in a cylindrical bucket, which is raised to the top of the head-frame, from which an inclined chute leads to the ground. A hinged extension of this chute is dropped into place beneath the bucket and a short fixed rope hooked to the bottom of the bucket. The bucket being then lowered is inverted by this rope. The stone slides down the chute into a small steel car which is run out on a narrow gage track to the dump.

PUMPING STATIONS.—The tunnels above described will serve three pumping stations, located as follows: 1, Stewart Ave. and 104th St.; 2, Western Ave. and 75th St.; 3, Yates Ave. and 126th St. The second of these will be reached by a new tunnel from 73d and State Sts.; this is not yet under contract. Each will have a pumping plant of 100,000,000 gals. daily capacity. The first to be built will be the one on Stewart Ave., known as the Roseland Station. This will have four vertical triple-expansion, condensing engines of the crank-and-flywheel type, each with a capacity of 25,000,000 gals. per 24 hours. The engines will be placed in a pump pit 100 ft. diameter, with the bottom 15 ft. 6 ins. below city datum, and will pump from a 25-ft. suction well whose top is 8 ft. above datum. No contracts have yet been let for the pumps or pumping stations.

POLK ST. TUNNEL.

While this new tunnel is not directly connected with the tunnels above described, it will be of interest to mention it here in its relation to the system of water tunnels. It is a new connection between a tunnel from the 14th St. pumping station and a tunnel running from the Chicago Ave. station to the station at Harrison and 22d Sts. It thus connects two or more pumping systems. The old 7-ft. tunnel extended across the

FIG. 3. STEEL SHEET-PILE LINING OF SHORE SHAFT, DRIVEN PREVIOUS TO EXCAVATION.

city from a shaft at Peck Court and Michigan Ave. (in Grant Park) to another at Harrison and Jefferson Sts., a distance of about 6,000 ft. It did not follow the street lines, but ran diagonally under the blocks, and in 1904 it was broken into by piles driven for a building foundation on Fifth Ave., north of Polk St. It was then decided to build a new 7-ft. tunnel between the same shafts, but running west under Polk St. and then north under Jefferson St., the total length being 6,122 ft. It is a circular tunnel, and was driven by the pneumatic process through sand, clay, gravel and other soft material. It has a 10-in. concrete lining, and where it passes under the river and under the tunnel of the Illinois Telephone & Tunnel Co. it is reinforced with hoops of 1-in. rods spaced 12 ins. c. to c. These hoops are 6 ins. from the inner face.

The two shafts had an octagonal timber lining, but in each case a steel shell had to be used in sinking through quicksand pockets. The shell was put down in 4-ft. rings, each ring in two parts. These were ¼-in. steel plate, having top and bottom flange angles for bolting to the rings above and below, and vertical flange angles for connecting up the two halves of each ring. As each ring was connected up, the shell was forced down by screw jacks. The tunnel excavation was done by hand, and the material hauled in cars on a track of 18-ins. gage to an electric elevator. In loose material the concrete lining was generally kept within 5 or 6 ft. of the face of the heading. Ribs of light steel channels were used to support the lagging, and were laid on an 18-in. stringer of concrete forming the middle of the invert. The contract for this was let Aug. 14, 1905, to the Jackson & Corbett Co., of Chicago, and work was completed early in 1907. The cost was about $150,000.

BLUE ISLAND AVE. TUNNEL.

This is another important improvement in the system of distributing tunnels under the city, and is to form a connection between the Chicago Ave. and 22d St. pumping stations. It will take the place of an existing tunnel, and its construction has been made necessary by the same conditions that led to the construction of the new Polk St. tunnel, noted above. The existing feeder tunnel runs diagonally across the city and is liable to injury in the construction of pile or caisson foundations for large buildings over the line of the tunnel. The new tunnel will follow the lines of the streets, and will thus be free from liability of injury by foundation works. It will be 26,550 ft. long, with 1,800 ft. of branches in addition. Only 750 to 1,000 ft. will be in rock, the balance being in clay, gravel and soft material. The main tunnel and branches will be of circular section, 8 ft. diameter, with a 10-in. concrete lining. The contract was awarded on April 6, 1907, to George W. Jackson, of Chicago, at $680,000. The work is to be completed by Dec. 31, 1907. Up to the middle of August about 1,000 ft. of tunnel had been driven, and work is in progress at headings driven from eight shafts, all of which are lined with steel sheet piling of the type already described.

The excavated material is hauled in small cars to the shafts and raised in iron buckets, which are dumped into wagons. Electric hoists are used, which are noiseless, occupy little space, and are free from the smoke and dirt incident to steam hoists. Ordinarily, the buckets would have to be wheeled or otherwise transported from the shaft to the dumping platform, but this movement is here effected automatically. Inclined timbers, extending across the shaft and over the platform, carry a little wheeled truck,

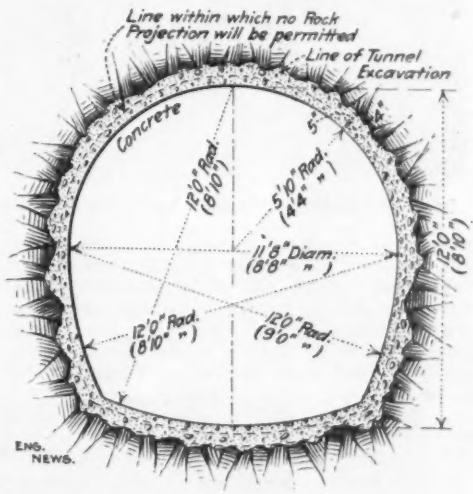


Fig. 5. Sections of Land Tunnels.

and the hoisting cable is led from the drum to the head of the timbers and back to a pulley under the truck. When the ascending bucket strikes the truck, the pull of the cable is changed from a vertical to a lateral direction, and the truck and bucket run up the incline to a position over the platform. In this way, no men are required to work at the edge of the shaft.

It is proposed to extend this tunnel under the lake to an existing intake shaft at the Carter H. Harrison crib (Engineering News, Aug. 31, 1899). With this new intake completed, the old "Two-Mile" crib would be removed and the three intake tunnels to that crib abandoned. Plans for this new lake tunnel are now being made.

MINOR CONNECTING TUNNELS.

In addition to the large tunnel works noted above, aggregating some 16½ miles, some minor, but important connecting tunnels are under construction, as follows: (1) Ashland Ave. Tunnel; 1,680 ft. of 10-ft. tunnel and two 10-ft. shafts. This is all in rock, with a 4-in. concrete lining. The contract was let Oct. 22, 1906, to John J. O'Heron & Co., at $62,000. (2) Indiana St. Tunnel; this is all in soft material and has a 12-in. concrete lining. The contract was let Oct. 31, 1906, to John P. Dougherty & Co., at $25,000. (3) Diversey Boulevard Tunnel; 450 ft., all in rock. This contract was let Dec. 8, 1906, to Geo. W. Jackson.

FIG. 4. TOWERS FOR AERIAL TRAMWAY TO WORKING CRIB.
(Beyond this crib, the tunnel strikes off towards the present intake crib, seen on the horizon.)

PHILADELPHIA REGULATIONS IN REGARD TO THE USE OF REINFORCED CONCRETE.

The building departments of most of our large cities are working upon the revision of their regulations for reinforced-concrete construction, so as to bring the rules which have generally been obsolete or useless, down to a conformity with more modern practice. The city of Philadelphia has been more particularly interested in this revision, owing to the occurrence there last summer of a serious failure, which was due to the non-observance of some of the most evident and primary rules of reinforced-concrete construction. A large portion of the new regulations recently issued by the city cover the routine part of the work, but we reprint below an abstract of the more important paragraphs of general interest to the profession.

The term "reinforced concrete" shall be understood to mean an approved concrete mixture reinforced by steel or iron of any shape, so that the steel or iron will take up all the tensional stresses and assist in the resistance to compression and shear.

Before a permit to erect any reinforced-concrete structure is issued, complete specifications and drawings shall be filed with the Bureau of Building Inspection, showing all details of the construction, size and position of all reinforcing rods, stirrups, etc., and giving the composition and proportions of the concrete.

The execution of the work shall be performed by workmen under the direct supervision of a competent foreman or superintendent.

Reinforced-concrete construction will be accepted for fireproof buildings of the first class, if designed as hereinafter prescribed; provided, that the aggregate for such concrete shall be clean, broken, hard stone, or clean graded gravel, together with clean siliceous sand or, fine grained gravel; should the concrete be used for flooring between rolled steel beams, clean furnace clinkers entirely free of combustible matter, or suitable seasoned furnace slag may be used; when stone is used with sand gravel it must be of a size to pass through a one-inch ring, and 25% of the whole must not be more than one-half the maximum size; and provided further, that the minimum thickness of concrete surrounding the reinforcing members of reinforced-concrete beams and girders shall be two inches on the bottom and one and one-half inches on the sides of the said beams and girders. The minimum thickness of concrete under slab rods shall be one inch. All reinforcement in columns to have a minimum protection of two inches of concrete.

All the requirements herein specified for the protection of steel and for fire-resisting purposes shall apply to reinforced-concrete flooring between rolled-steel beams, as well as to reinforced-concrete beams and to entire structures in reinforced concrete. Any concrete structure or the floor filling in same, reinforced or otherwise, which may be erected on a permanent centering of sheet metal, of metal lathing and curved bars or a metal centering of any other form, must be strong enough to carry its load without assistance from the centering, unless the concrete is so applied as to protect the centering as herein specified for metal reinforcement.

Exposed metal centering or exposed metal of any kind will not be considered a factor in the strength of any part of any concrete structure, and a plaster finish applied over the metal shall not be deemed sufficient protection unless applied of sufficient thickness and properly secured, as approved by the Chief of the Bureau of Building Inspection.

All concrete shall be mixed in a mechanical batch mixer to be approved by the Bureau of Building Inspection, except when limited quantities are required or when the condition of the work makes hand mixing preferable; hand mixing to be done only when approved by the Bureau of Building Inspection. In all mixing the material shall be measured for each batch.

All forms to be properly supported and braced in a manner to safely sustain the dead load and the load that may be imposed upon them during construction.

The reinforcing steel shall be accurately located in the forms and secured against displacement.

Concrete shall be placed immediately after mixing.

Whenever fresh concrete joins concrete that is set, or partially set, the surface of the old concrete shall be roughened, cleaned and spread with cement mortar, which mortar shall be mixed in proportions of one of cement to two of sand.

Concrete shall not be mixed or deposited in freezing weather, unless precautions are taken to avoid the use of material covered with ice or snow, or that are in any other way unfit for use, and that further precautions are taken to prevent the concrete from freezing after being put in place. All forms under concrete so placed to remain until all evidences of frost are absent from the concrete and the natural hardening of the concrete has proceeded to the point of safety.

Concrete laid during hot weather shall be drenched with water twice daily, Sunday included, during the first week. The broken stone, if hot and dry, must be wet before going to the mixer.

The time at which props or shores may safely be removed from under floors and roofs will vary with the condition of the weather, but in no case should they be removed in less than two weeks; provided, that column forms shall not be removed in less than four days; provided further, that the centering from the bottom of slabs and sides of beams and girders may be removed after the concrete has set one week, provided, that the floor has obtained sufficient hardness to sustain the dead weight of the said floor and that no load or weight shall be placed on any portion of the construction where the said centers have been removed.

The concrete for all girders, beams, slabs and columns shall be mixed in the proportions of one of cement, two of sand or fine gravel, and four of other aggregates as before provided. The concrete used in reinforced-concrete construction must be what is usually known as a "wet" mixture. When the concrete is placed in water it must be placed in a semi-dry state.

Only Portland cement shall be permitted in reinforced-concrete constructed buildings. All cement shall be tested, in carload lots when so delivered or in quantities equal to same, and report filed with the Bureau of Building Inspection before using it in the work. Cement failing to meet the requirements of the accelerated test will be rejected.

Reinforced concrete may be used in place of brick and stone walls, in which cases the thickness may be two-thirds of that required for brick walls, provided the unit stresses as set forth in these regulations are not exceeded.

Concrete walls in such cases must be reinforced in

FIG. 6. EXCAVATION OF 12-FT. ROCK TUNNEL UNDER 73D ST.

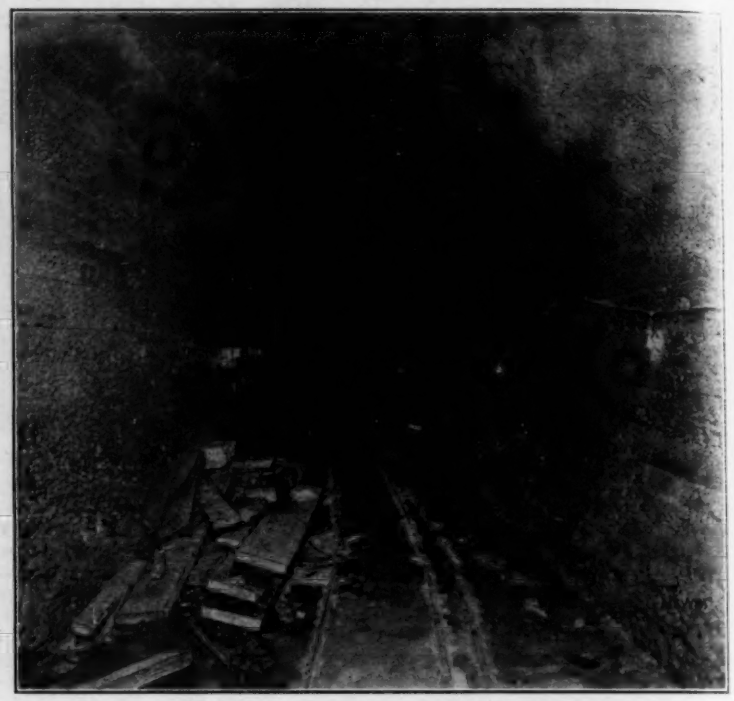


FIG. 7. A COMPLETED SECTION OF 12-FT. TUNNEL.

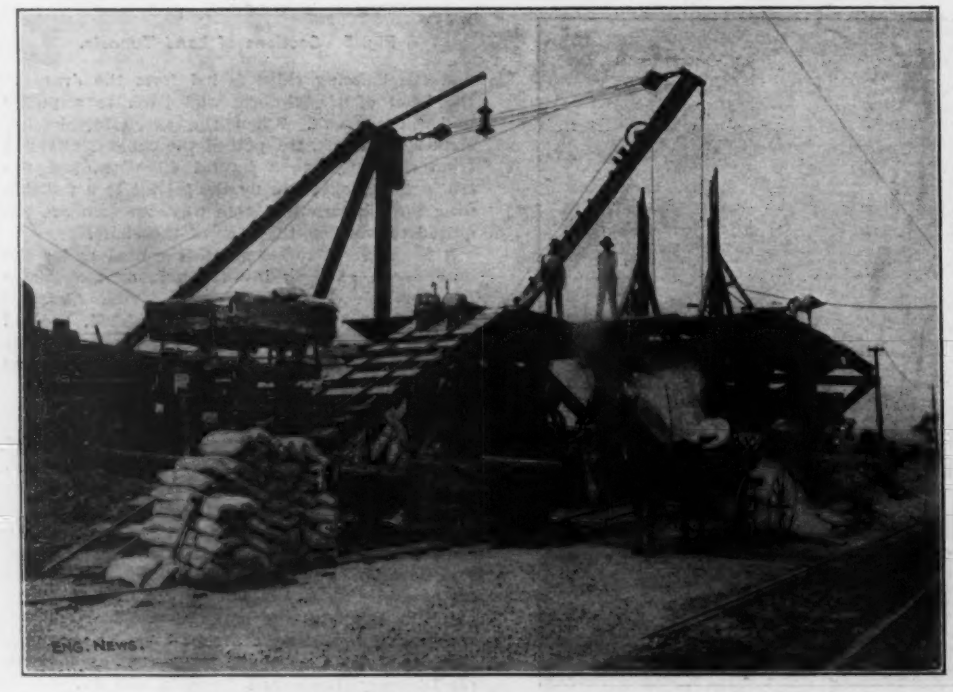


FIG. 8. HEADWORKS AT SHAFT ON 73D ST. TUNNEL.

(This shows the stiff-leg derrick of the shaft hoist; the mixer with incline for material; at the right, under the platform, is the dump car conveying material from t he tunnel cars to the dump.)

both directions in a manner to meet the approval of the Chief of the Bureau of Building Inspection.

Reinforced-concrete slabs, beams and girders shall be designed in accordance with the following assumptions and requirements:

(a) The common theory of flexure to be applied to all beams and members resisting bending.

(b) The adhesion between the concrete and the steel is sufficient to make the two materials act together.

(c) The design shall be based on the assumption of a load four times as great as the total load (ordinary dead load plus ordinary live load).

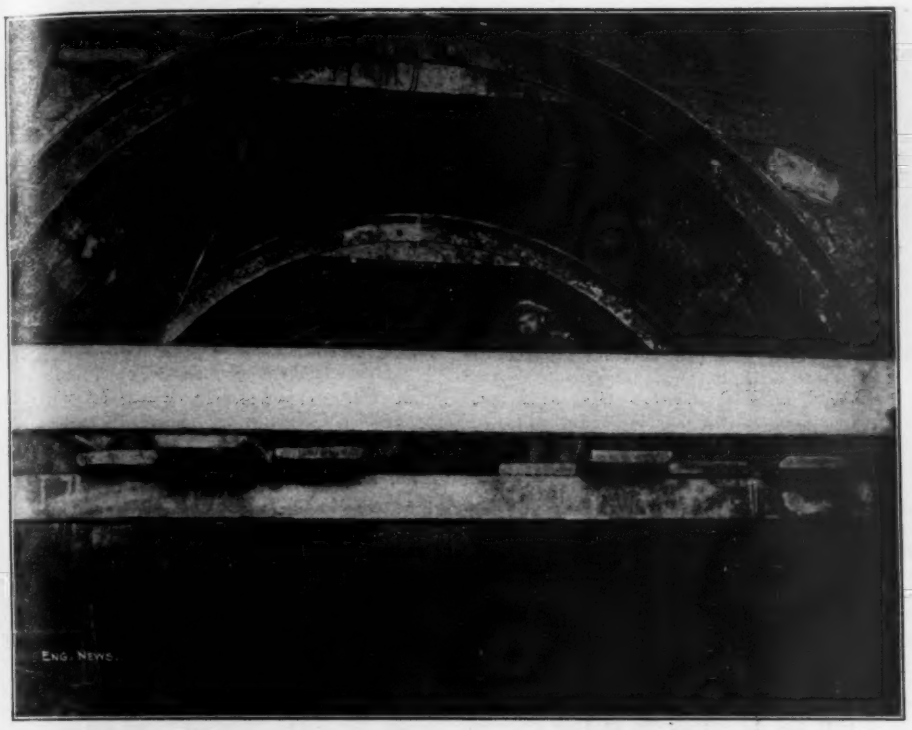


FIG. 9. STEEL CENTERING IN 12-FT. TUNNEL.
(Through the lagging is seen an unusually large hole above the roof line.)

(d) The steel to take all the tensile stresses.

(e) The stress-strain curve of concrete in compression is a straight line.

(f) The ratio of the moduli of elasticity of concrete to steel:

Stone or gravel concrete	1 to 12
Slag concrete	1 to 15
Cinder concrete	1 to 30

The allowable unit transverse stress upon concrete in compression:

Stone or gravel concrete	600 lbs. per sq. in.
Slag concrete	400 lbs. per sq. in.
Cinder concrete	250 lbs. per. sq. in.

The allowable unit transverse stress in tension:

Iron	12,000 lbs. per sq. in.
Steel	16,000 lbs. per sq. in.

The allowable unit shearing strength upon concrete:

Stone or gravel concrete	75 lbs. per sq. in.
Slag concrete	50 lbs. per sq. in.
Cinder concrete	25 lbs. per sq. in.

The allowable unit adhesive strength of concrete:

Stone or gravel concrete	50 lbs. per sq. in.
Slag concrete	40 lbs. per sq. in.
Cinder concrete	15 lbs. per sq. in.

The allowable unit stresses upon concrete in direct compression in columns:

Stone or gravel concrete	50 lbs. per sq. in.
Slag concrete	300 lbs. per sq. in.
Cinder concrete	150 lbs. per sq. in.

The allowable unit stress upon hoop columns composed of stone or gravel concrete shall not be over 1,000 lbs. per sq. in., figuring the net area of the circle within the hooping. The percentage of longitudinal rods and the spacing of the hoops to be such as to permit the concrete to safely develop the above unit stress with a factor of safety of four.

When steel or iron is in the compression sides of beams the proportion of stress taken by the steel or iron shall be in the ratio of the modulus of elasticity of the steel or iron to the modulus of elasticity of the concrete; provided, that the rods are well tied with stirrups connecting with the lower rods of the beams; provided, further, that when rods are used in compression, the approval of the Chief of the Bureau of Building Inspection must be obtained.

In the design of structures involving reinforced-concrete beams and girders, as well as slabs, the beams and girders shall be treated as T-beams, with a portion of the slab acting as flange in each case. The portion of the slab that may be used to take compression shall be dependent upon the horizontal shearing stress that may exist in the beam, and in no case shall the slab portion exceed 20 times the thickness of the slab.

All reinforced-concrete T-beams must be reinforced against the shearing stress along the plane of junction of the rib and the flange, using stirrups throughout the length of the beam. Where reinforced-concrete girders carry reinforced-concrete beams, the portion of the floor slab acting as flange to the girder must be reinforced with bars near the top, at right angles to the girder, to enable it to transmit local loads directly to the girder and not through the beams, thus avoiding an integration of compressive stresses due to simultaneous action as floor slab and girder flange.

In the execution of work in the field, work must be so carried on that the ribs of all girders and beams shall be monolithic with the floor slabs.

In all reinforced-concrete structures special care must be taken with the design of joints to provide against local stresses and secondary stresses due to the continuity of the structures.

Shrinkage and thermal stresses shall be provided for by the introduction of steel.

In the determination of bending moments due to the external forces, beams and girders shall be considered as simply supported at the ends, no allowance being made for continuous construction over supports. Floor slabs, when constructed continuously, and when provided with reinforcement at top of slab over the supports, may be treated as continuous beams, the bending moment for uniformly distributed loads being taken at not less than $\frac{WL}{10}$ in case of square floor slabs which are reinforced in both directions and supported on all sides, the bending moment may be taken at $\frac{WL}{20}$; provided, that in floor slabs in juxtaposition to the walls of the building the bending moment shall be considered as $\frac{WL}{8}$, when reinforced in one direction, and if the floor slab is square and reinforced in both directions, the bending moment shall be taken as $\frac{WL}{16}$.

When the shearing stresses developed in any part of a reinforced-concrete building exceed under the multiplied loads the shearing strength as fixed in this section, a sufficient amount of steel shall be introduced in such a position that the deficiency in the resistance to shear is overcome.

When the safe limit of adhesion between the concrete and steel is exceeded, provision must be made for transmitting the strength of the steel to the concrete.

Reinforced concrete may be used for columns in which the ratio of the length to least side or diameter does not exceed 15. If more than 15 diameters the allowable stress shall be decreased proportionally. Reinforcing rods that are introduced for lateral stresses must be tied together at intervals of not more than the least side or diameter of the columns.

Longitudinal reinforcing rods will not be considered as taking any direct compression.

The contractor must be prepared to make load tests in any portion of a reinforced-concrete building within a reasonable time after erection, and as often as may be required by the Chief of the Bureau of Building Inspection. The tests must show that the construction will sustain a load equal to twice the calculated live load without signs of cracks.

AN ELECTRICALLY EQUIPPED LEAD MINE.

By HENRY FLOY,* Assoc. Am. Inst. E. E.

Joplin, Missouri, has for a long time been looked upon as one of the principal centers of zinc and lead production of this country. Recently, however, a new lead district of growing reputation has sprung up in the territory directly south and between fifty and sixty-five miles from St. Louis, where one county is at present producing about 25% of the lead output of the United States. One of the earlier developments in this section was made at St. Francois by the St. Louis Smelting & Refining Co. of St. Louis, which is now mining 1,500 tons of ore and shipping about 150 tons of concentrates per day.

The St. Louis Co. began operations in 1900 and was the first company in the country to entirely equip and operate a lead mine by electricity. It had been the previous practice to use shafting, belts and gears in the concentrating mills and separate installations of boilers and engines at each shaft for hoisting, but the officers of the St. Louis Company recognizing the recent advances that had been made in electrical power

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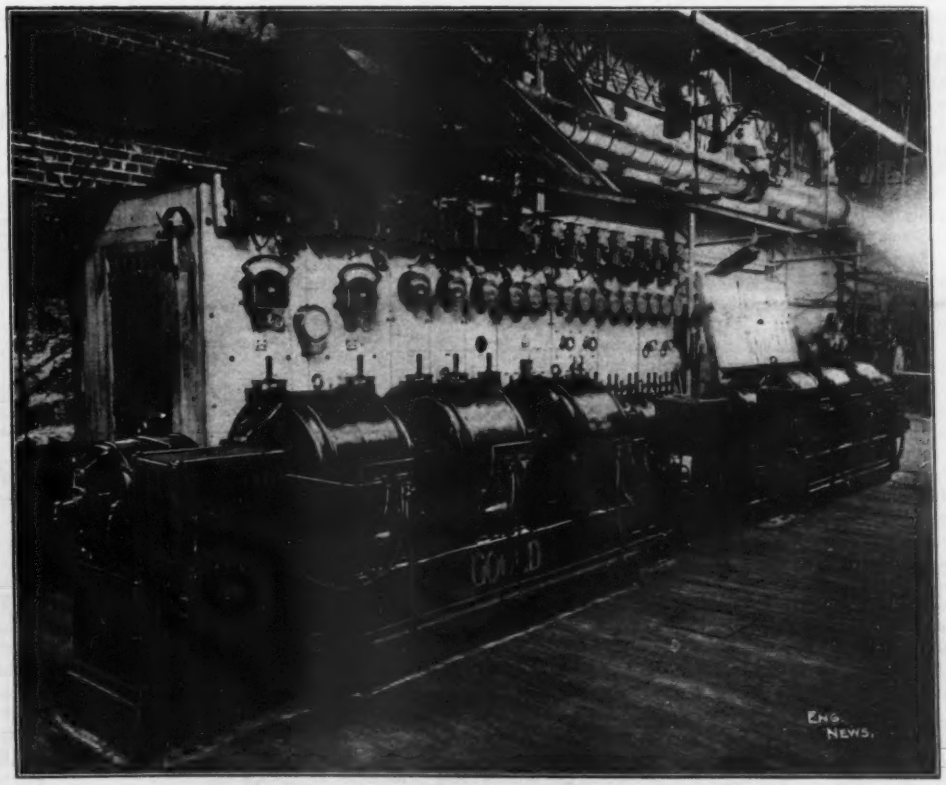


FIG. 1. BOOSTER SETS, GOULD STORAGE BATTERY SYSTEM, ST. LOUIS SMELTING AND REFINING CO., ST. FRANCOIS, MO.

distribution, early retained a consulting engineer to advise them regarding the advantages to be gained by the use of electricity.

The power plant at St. Francois contains six 300-HP. water-tube boilers, equipped with underfed stokers, and an engine driven fan for forced draft. The fuel used is Illinois coal, which is obtained from mines just across the Mississippi River in Illinois. It is dumped from the cars into bins from which it is elevated by means of

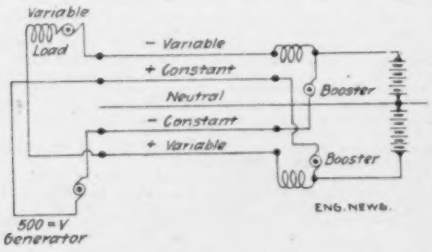


Fig. 2. Simplified Diagram of Scheme for Equalizing Variable Load.

buckets on an endless belt to hoppers above the boilers, and thence supplied through chutes to the stokers.

The engine-room contains one 850-HP., 22 and 42 × 48-in. 90-R. P. M., cross-compound, condensing, Filer & Stowell engine belted to the main line shaft in the concentrating mill and also direct-connected to a 250-KW., 500-volt General Electric direct-current generator. Originally there was also installed one 16 and 30 × 42-in. 90-R.P.M., cross-compound, condensing engine direct-connected to a 250-KW., 500-volt generator, and this summer there has been installed a second 250-KW. unit, a duplicate of the one just described. These three units furnish electricity to operate all the machinery on the property of the smelting company, except that driven by belt from the main engine, the air drills in the mines and two steam mine pumps. Two 100-KW., 500—250-volt motor-generator sets have recently been installed to supply current for the single-trolley, mine haulage system, just put into operation.

There are also two specially designed water-cooled, two-stage, Filer & Stowell air compressors, with cylinders 20 and 34 × 48 ins. on the steam end and 16½ and 28 × 48 ins. on the air end. These compressors supply air for the rock drills used in the five shafts being operated on the property of the company. All the engines exhaust to a Worthington central condenser. There is a complete marble switchboard, equipped with the usual apparatus, and in addition, with two sets of bus-bars, one for constant loads and one for fluctuating loads, also with recording wattmeters for generator and feeder circuits and for input and output of the storage batteries.

The electrical energy is supplied for:

(1) A practically constant motor load, consisting of pumps, the machine and carpenter shops, and much of the concentrating machinery in the mill.

(2) A heavy fluctuating load, consisting of locomotives, transfer cars and mine hoists.

(3) A 250-volt lighting load supplied through a three-wire system having its neutral connected to the center of a storage battery.

Originally there was installed a regulating battery, having a maximum capacity of 400 amperes. However, with the opening of new shafts and other extensions, the installation of a second battery of the same size became necessary. Both the present batteries with the duplicate booster sets, shown in Fig. 1, were supplied by the Gould Storage Battery Co., and constitute one of the most unique battery and booster installations ever made.

The constant load bus-bars, to which are connected the feeder circuits for the lights and the constant load motors, are directly connected to the generator terminals. The second set of bus-bars, to which are connected the fluctuating load feeder circuits, are not connected with the main current supply except through the series boosters; thus the current passing through the boosters is furnished to either the fluctuating load or the storage battery, depending upon whether the fluctuating loads are demanding energy or not. Reference to the simplified diagram of connections, Fig. 2, will make clear the fact that any sudden demand for current by a fluctuating load will first draw on the constant supply being furnished by the constant current boosters up to that amount and then the battery will begin to feed into the variable load bus-bars in multiple with the boosters, thus providing for any momentary demand. As soon as the fluctuating load is discontinued, the constant current from the boosters passes into the battery, recharging it.

The neutral of the three-wire lighting system is taken from the mid-point of the battery, thus allowing the use of 250-volt incandescent lamps. Ordinarily, a motor and booster constitute a set, but in this installation the voltage of 500 is split in two by the neutral connected to the mid-point of the battery. As the lighting loads will, from time to time in practice, be more or less unbalanced, it is necessary to be able to recharge either half of the storage battery independently. This requires, therefore, a booster for each half of the battery. The Gould system of booster regulation includes a separate and small machine, known as a "counter-electromotive-force" generator, which regulates the voltage of the booster instead of dependence being placed upon a differential winding for the booster field, as has been the more usual practice. Thus the necessity for five machines in a set, as shown in Figs. 1 and 3, will be appreciated. In these figures the machine shown in the center is the motor, the two machines on each side of the motor are the boosters and the small machines on the extreme ends are the counter-electromotive-force generators. Fig. 3 is a development of the simple scheme of Fig. 2 and shows the operation of the actual system. It is evident that the halves shown in this diagram are duplicates. Each is a development of Fig. 2.

The Gould C. E. M. F. for booster regulation operates as follows: The booster and C. E. M. F. generator or counter machine are driven at approximately constant speed by the motor. The heavy field of the counter machine is in series with the booster armature and the load to be regulated, so that the strength of this field varies with the load.

When the variable load is heavy, current is being supplied from the booster armature (through the series field of the C. E. M. F. generator) and from the battery in parallel. When there is no variable load the constant current is being supplied to the battery. The armature on the counter machine is connected between the neutral and one side of the variable busses, and having in series with it the field winding of the booster.

The voltage in the armature of this counter machine being controlled by its field, likewise varies as the load. The supply circuit voltage being constant it is evident that the voltage impressed on the booster field will vary in direction and amount according as the voltage of the counter machine is higher or lower than that of the circuit. Assuming the voltage of the counter machine to be proportional to the current in its field it is evident that by winding the booster field so that the necessary booster voltage may be obtained with a definite booster field voltage, if e., a definite difference between the voltage of the counter machine and that of the line, we can definitely fix the variation allowed in the current to be regulated.

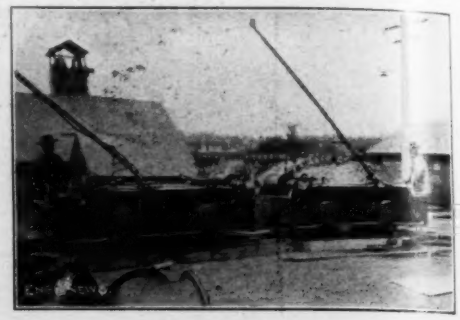


Fig. 4. Mine Haulage Electric Locomotives, Baldwin-Westinghouse, 4-Ton Type.

This current to be regulated is of course that supplied to the variable load through the armature of the booster. The amount of the generator load is regulated by shunts placed in parallel with the field winding of the counter machine. These shunts with their switches mounted on the counter machines, are shown in Fig. 1. It will be noted that the percentage of regulation remains the same irrespective of the number of shunts in circuit. By means of the rheostats, shown in Fig. 3, in parallel with the booster field the percentage of regulation can be changed to provide for exceptional heavy conditions, so as to divide the load variations between the battery and generators.

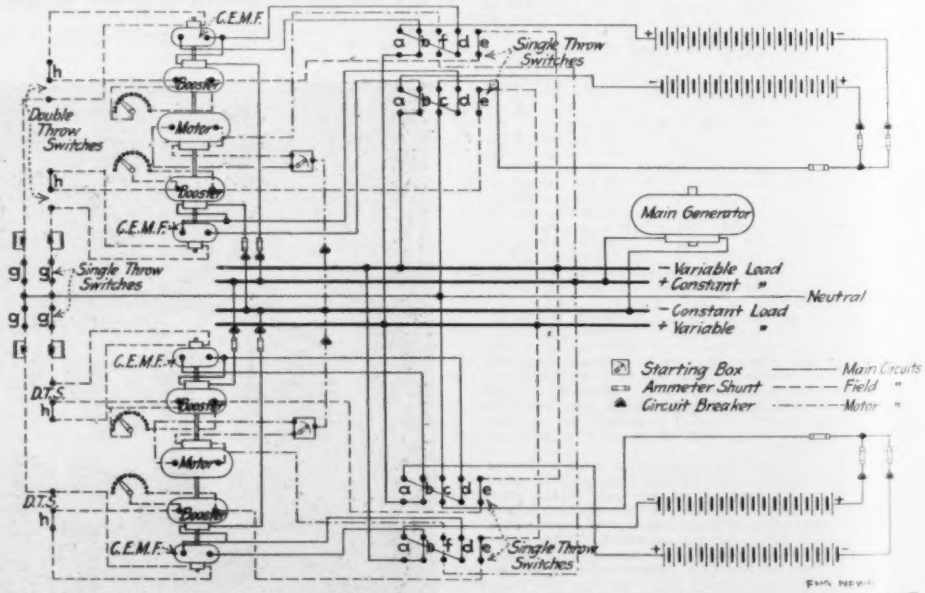


FIG. 3. DIAGRAMMATIC ARRANGEMENT OF APPARATUS AND CONNECTIONS, STORAGE BATTERY PLANTS OF THE ST. LOUIS SMELTING AND REFINING CO., ST. FRANCOIS, MO.

The installation is so arranged that each booster set can supply its own battery independently of the other, either booster set can be used to supply the other's battery or both batteries at the same time; or both booster sets can be operated in multiple to supply either battery singly or both batteries in multiple.

In the diagrammatic arrangement of Fig. 3 the proper switches are shown as closed for normal operation. The system is brought into this condition as follows: Closing the switches marked "f" allows the motors to be started; closing

those marked "c" throws the mid-point of the batteries onto the neutral bus; closing "e," "g" and "h" as shown, connects the armature of the C. E. M. F. generators through the booster fields between the neutral and the proper variable load busses; closing "b" throws in the booster armature between the constant load busses and the variable load busses; closing "d" throws the

FIG. 5. 35-TON, 200-HP. ELECTRIC LOCOMOTIVE, BUILT IN THE SHOPS OF THE ST. LOUIS SMELTING AND REFINING CO.

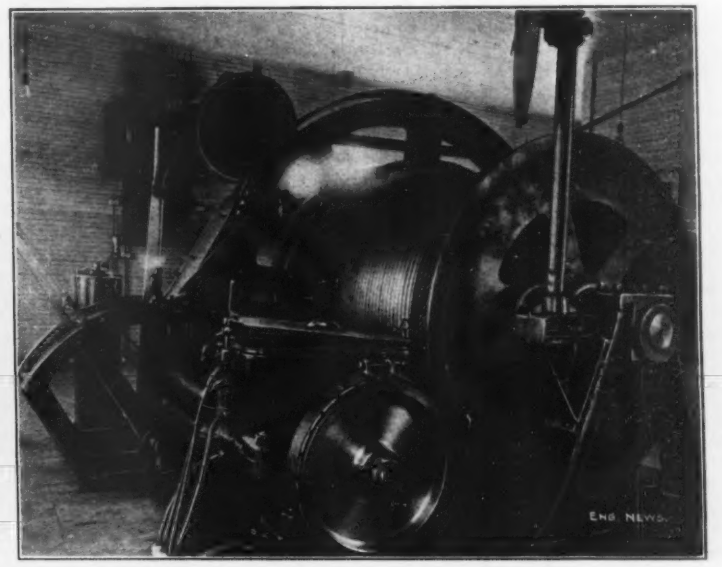


FIG. 6. TYPE OF ELECTRIC MINE HOIST, USED AT MINES OF ST. LOUIS SMELTING AND REFINING CO., ST. FRANCOIS, MO.

halves of each battery into multiple with the boosters.

By manipulation of the switches "h" the boosters can be used to charge the battery, with the counter machines out of service. Regulation is obtained in such an event by hand adjustment of the field rheostat.

Closing those switches marked "a" and opening all others allows the batteries to "float" on the variable load busses with the boosters shut down.

A noticeable comment on the advantage of the storage battery installation is the fact that during a considerable portion of the twenty-four hours' daily operation of the plant one generator and the two storage batteries have been able to successfully carry the load, the engine operating at full capacity; whereas, with the storage batteries cut out of service, two generators must be kept in operation, running part of the time at overload and much of the time underloaded in order to meet the varying demands of the fluctuating loads.

The lead ore is about 450 ft. below the surface, and after being mined is conveyed to the shafts in ore cars holding one ton each. These cars until the present year, have been drawn by mules, but the company has just installed a complete system of electric haulage, consisting of five, four-ton, two-motor Baldwin-Westinghouse electric locomotives, two of which are shown in Fig. 4. These locomotives are replacing 30 mules, and in addition will do considerably more work than could be done by the mules. On account of danger from contact with the trolley wire, it was decided to use 250 volts for the underground system. Two motor-generator sets have been installed to take current from the main generators and deliver it at 250 volts to the mine trolley system. The motor-generators have the negative connected to the rail.

From the beginning of the work the company has operated a double-trolley, 500-volt locomotive for doing the hauling about the yards. It was considered inadvisable by the consulting engineer to install a grounded trolley circuit, as the greater part of the electrical energy used was consumed in motors operating mine hoists, pumps, crushers and machinery in the mill. The original locomotive of 20-ton capacity has been replaced by a 35-ton locomotive, shown in Fig. 5. This locomotive was built in the machine shop of the smelting company and is equipped with four 50-HP. General Electric railway motors and furnished with air brakes and all other necessary apparatus. This locomotive, shown in Fig. 5, will handle fourteen 100,000-lb. cars of the type shown. The two trolley wires, positive and negative, are suspended, for the most part, from side poles and brackets. No. 00 grooved trolley wire is used throughout with standard General Electric fittings and suspensions, with the exception of the cross-overs which are special on account of the proximity of the two trolley wires. At all turnouts and some of the switches, span wire suspensions are employed. The trolley line from the mill to Shaft No. 3 is about 1½ mi. long and to Shaft No. 5 about 1 mi.; it also connects with two lines of steam railroads. In all there are about four miles of single track equipped with oak ties and 60-lb. rails. Although the double trolley requires somewhat more attention than the single trolley, the operation on the whole has been very satisfactory, particularly on account of the avoidance of grounding the motors on the power circuits. From comparative tests it is found that electric haulage can be maintained at about 45% the expense, including repairs, that with steam boilers.

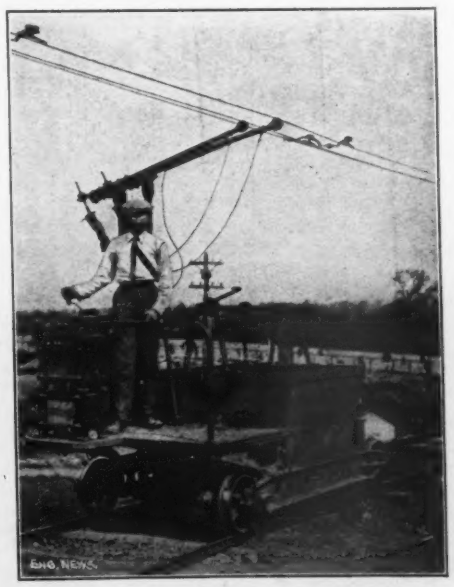


Fig. 7. Electrically-Operated Ore Transfer Car.

The ore cars from the mines are hoisted from the various levels to the surface by electrically-operated hoists, equipped with 50-HP. motors, and having a capacity of 2,000 lbs., unbalanced load, at a speed of 1,000 ft. per min. It is found that the entire power consumption for hoisting averages less than 2 watts hours per ton per ft. of ore hoisted, which makes the cost but a small percentage of that of hoisting by steam. When brought to the surface, the loads are delivered to a transfer car by which they are conveyed to ore bins or crushers, into which the ore is dumped. Illustration of one of the motor-hoists is shown in Fig. 6 and one of the transfer cars built at the works, in Fig. 7.

With the development of the turbine centrifugal pump, the high-duty, direct-connected steam pumps originally installed in the mines have been gradually replaced by the newer type of motor-driven pumps, which are proving very satisfactory. The economy in operation effected by the substitution of electric pumps for steam pumps with their long lines of piping, is quite marked and the expense of maintaining the former is but a small proportion of that of the steam pumps.

Ore from the various shafts is brought to a central crushing plant equipped with Gates' gyratory crushers driven by 100-HP. motors. After the first crushing the ore is conveyed by endless belts to the mill, where, passing through secondary crushers it is reduced to pieces an eighth to a quarter of an inch in size. The crushed ore is dropped into one of four large jigs, of a new type, thence, the finer grades pass to "slime tables," which separate the lead from the rock in water, by gravity. All crushed material is handled in water by centrifugal pumps driven by direct-connected motors. After separation the lead ore is known as "concentrates," being about 70% pure lead, and is shipped to the company's smelter at Collinsville, Ill., for reduction.

Since 1900, the writer has continuously acted as Consulting Engineer of the St. Louis Smelting & Refining Co., in connection with the original plant and its extensions at St. Francois, Mo., and also for the smelting plant erected at Collinsville, Ill. The Superintendent of the company is Mr. Chas. E. Schwarz, Mem. Am. Inst. Min. E., to whose efficient management is largely due the satisfactorily low costs of production.

A WATER PURIFICATION PLANT of special interest is now being built for the Union Stock Yard & Transit Co., at Chicago. In order to increase its supply the company proposed to take water directly from the peculiarly foul dead-end of the Chicago River, known as Bubbly Creek, and to treat it by some purifying process. An experimental mechanical-filter plant was built, using sulphate of iron, sulphate of copper and caustic lime. On the basis of the results obtained, a plant of 5,000,000 gals. daily capacity is now being built. The Health Department, however, has made objections to the use of this water for any purposes besides washing and flushing. The process of treatment, more particularly the use of the chemicals named, was developed by the American Steel and Wire Co., of Chicago, and the plant is being built by the Norwood Engineering Co., of Florence, Mass.

A NEW BELT RAILWAY AT KANSAS CITY.

The Kansas City Outer Belt & Electric Ry., now under construction, is intended to form the terminal line of the Kansas City, Mexico & Orient Ry., and also to provide for interchanging traffic between the 15 or 16 trunk lines centering at this point. It will also serve a number of industries along its route, and the charter permits it to be utilized as a terminal line for electric interurban roads. It commences by a junction with the K. C., M. & O. Ry. at Indian Creek, near the Kansas (or Kaw) River, west of Kansas City, Kan. Here a large freight yard is to be established, and a line extends down the river southeast to a point opposite Argentine, where connections will be made with several roads. The main part of the road extends from the freight yard around the west and north sides of Kansas City, Kan., following generally the line of Jersey Creek. On reaching the Missouri River the road branches; one portion will continue east across the river to connect with various roads and terminating in a large freight yard. The other portion will turn south, crossing the mouth of the Kansas River and extending to the Union Station in Kansas City, Mo.

The line will be about seven miles long, and its maximum grade will be 1%, which is said to be much lighter than those on other belt and terminal roads at Kansas City. It will be double track throughout, ballasted with broken stone, and laid with 80-lb. rails on creosoted ties with tie-plates (or perhaps on steel ties). The heaviest cut is about 3,500 ft. long, with a maximum depth of 65 ft.; 25% of the excavation is in solid rock. This cut is being made with a 2½-yd. Bucyrus steam shovel, which is served by three trains of 5-yd. dump cars running on a construction track of 3-ft. gage.

There are a number of plate girder bridges and Jersey Creek is crossed four times by bridges of this type, of 35 ft. to 52 ft. span. All other drainage openings are box culverts of reinforced concrete. The Kansas City Western Electric Ry. is carried over the west end of the big cut by a 62-ft. deck plate girder span. Near the western end of the line (beyond Armourdale) the parallel tracks of the Union Pacific Ry. and the Chicago, Rock Island & Pacific Ry. are crossed by a bridge comprising a through truss span of 146 ft. 9 ins., and a plate girder span of 51 ft. The adjacent ends of these two spans are carried by a steel bent having three columns, each built up of two channels and lacing bars. This carries the fixed end of the truss span, and the expansion end of the girder span. This bridge, which is shown in Fig. 1, is on a skew of 37° 32', and each span has three trusses or girders 17 ft. c. to c. The weight is 363 tons for the truss span, 91 tons for the girder span, and 20 tons for the bent, or 474 tons in all. The loading for these bridges consists of two consolidation engines (109 ft. over all) with 50,000 lbs. on each driving axle (5 ft. c. to c.), 25,000 lbs. on each truck axle, and 30,000 lbs. on each tender axle; these are followed by a train load of 4,500 lbs. per ft. of track. The deck plate girder spans over Jersey Creek were designed for Waddell's class U loading.

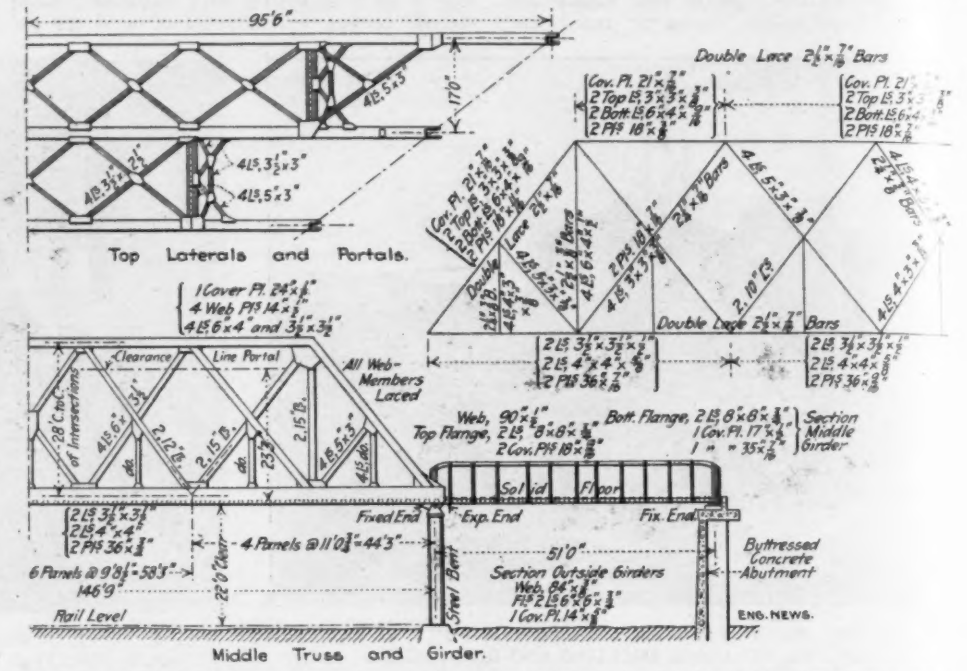


FIG. 1. SKEW BRIDGE WITH SOLID FLOOR; KANSAS CITY OUTER BELT & ELECTRIC RY.

The trusses of the skew bridge above noted are of riveted construction, as shown, and one of the interesting features is the solid floor construction. This, as shown in Fig. 3, consists of rectangular troughs, 10⁷/₃₂ ins. to 11⁹/₃₂ ins. wide, and 13¼ ins. deep; they are secured to the bottom chords by gusset plate connections. Very large ties are used, 8 x 10 ins. (on edge) and 10 ft. long. In each trough are two blocks 4½ x 8 ins., 2 ft. long, upon which the ties rest, the tops of the ties being thus 1⅛ ins. clear above the tops of the troughs. Outside guard timbers are used, boxed out ½-in. for the ties, and secured at every tie by a ⅞-in. bolt which passes through the tie, block and bottom plate of trough. The same floor construction is employed on the adjacent girder span. Spans over streams have open floors.

All masonry is of concrete, reinforced with Johnson corrugated bars, and the buttressed type of design is employed for abutments and wing walls. The concrete is composed of Kaw River sand, Iola Portland cement, and crushed stone in proportions of 1:3:5. For the bridge seats a mixture of 1:2:4 is used. In Fig. 3 is shown one of the abutments of the bridge over the railway tracks, already mentioned, which is on a skew of 37° 32'. This is of the buttress type, the thin face wall being backed by inclined buttresses resting on the foundation slab. These buttresses

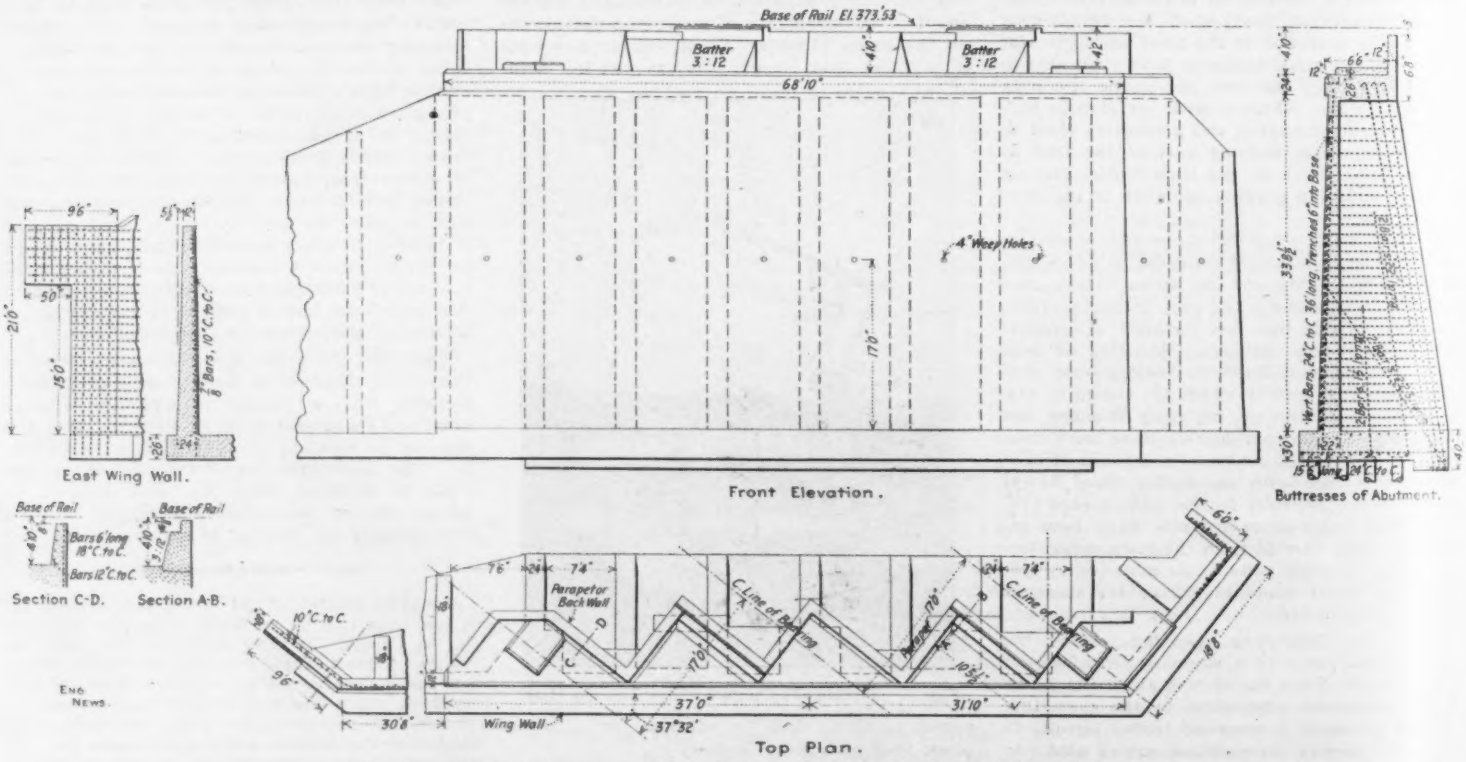


FIG. 3. BUTTRESS TYPE OF REINFORCED CONCRETE BRIDGE ABUTMENT.

also support the top slab on which are the bridge seats, and at the back of this latter slab is a parapet or curb wall 4 ft. 2 ins. high. The horizontal reinforcing bars in the buttresses are hooked at one end to engage with the horizontal bars in the face of the abutment wall.

About 75% of the grading west of the Missouri River has been completed, with masonry also completed and nearly all of the steel superstructures erected. This part of the line will be completed early in 1908, but nothing has yet been done in regard to the two large bridges at the eastern end, crossing the Missouri and Kansas rivers. The general contractor is Mr. L. J. Smith, of Kansas City, Mo. The contract for the heavier bridge work was awarded to the American Bridge Co., while some of the Jersey Creek bridges were let to the Midland Bridge Co., of Kansas City, Mo. Mr. Ira G. Hedrick, M. Am. Soc. C. E., is Consulting Engineer for the steel bridge work. The road is being built under the direction of the Kansas City, Mexico & Orient Ry., the officers being the same for both roads. Mr. A. E. Stilwell is President; Mr. E. Dickinson, General Manager; and Mr. M. P. Paret, M. Am. Soc. C. E., Chief Engineer. For information and drawings we are indebted to Mr. Albert T. Canfield, Assistant Engineer of the K. C., M. & O. Ry.

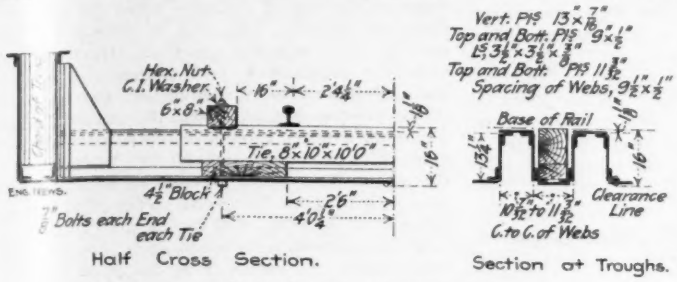


FIG. 2. SOLID FLOOR CONSTRUCTION.

THE SECOND INTERNATIONAL AERONAUTIC RACE FOR THE BENNETT TROPHY.*

When Lieut. Frank P. Lahm, U. S. A., won the first international balloon race, the trophy offered by Mr. James Gordon Bennett was brought to this country to be defended by the Aero Club of America.

Lieut. Lahm traveled from Paris to the North of England, a distance of some 402 miles, and his victory over the foreign competitors was due to a greater knowledge and better judgment of the altitudes at which he might utilize the most favorable air currents. St. Louis was selected as the most suitable place in America for this year's race, and it was expected that some new long-distance and time records would be established, although the contest was to be entirely for distance. Six balloons were brought over from Europe to compete for the Bennett trophy. Of these three came from Germany, two from France and one from England. Three American balloons were entered. The capacity limit of the balloons entered was placed at 75,000 cu. ft., with an excess allowance of 5%, making a gross allowance of about 80,000 cu. ft. available. Each of the balloons entered was close to the limit, ranging from 75,000 to 79,500 cu. ft. capacity. It is interesting to note that, although motor-driven balloons were allowed to compete, none were entered, and all the operators depended on their skill in utilizing the prevalent air currents to reach their destinations—wherever those might be.

Maps and all available information was placed at the foreign competitors disposal that they might acquaint themselves with the general course of air currents in the United States and especially in the region of St. Louis. Under such conditions the pilots should have competed on nearly equal terms in this regard. In the basket of each balloon were only two persons, the pilot and one assistant. It was necessary that these men should be well protected against the cold of the season and altitudes to be reached, as no fire of any sort could be allowed on account of the gas in the bag. Each balloon carried provisions and several instruments, such as a compass, registering aneroid barometer, statiscope (to indicate the rise and fall of the balloon), thermometers, besides charts and small electric flash-lamps for reading the instruments and charts at night. The baskets were equipped with cork in one way or another so that they might float in case a balloon should drop into water. It should be remarked that no accident of this kind occurred to any competing balloon, nor did any pilot find it necessary to throw his instruments overboard or to cut loose the car, as he was allowed to do under governing rules.

The balloons were first reported as having drifted around at different heights in search of a favorable steady air current and had finally settled to an easterly course. Eight of the balloons were reported while crossing Indiana and Ohio as sailing in an easterly direction. Late Oct. 22, Major Henry B. Hersey, of the United States Weather Bureau, in the balloon "United States," descended on the shores of Lake Ontario, some 650 miles, in a direct line, from St. Louis. This was the shortest course with the exception of the English balloon, which descended half way across Ohio on account of the sickness of the pilot. It should be noted that Major Hersey was the one competitor who has made a close study of air currents in this country and was the only one who was able to maintain the northeasterly course which the pilots hoped to follow. However, he was handicapped by a leaking balloon and, with his ballast almost exhausted, he was obliged to descend on seeing Lake Ontario. Without these handicaps he should have been able to hold the current which he had found and to have crossed Lake Ontario, when he would have had a clear field of hundreds of miles further before reaching the Atlantic Ocean. This is indicated in Fig. 1, which shows the general course of the nine balloons competing.

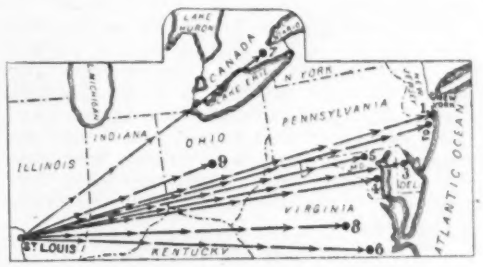


Fig. 1. General Courses of the Balloons in the St. Louis International Race.

(1) The Pommern, (2) L'Isle de France, (3) Düsseldorf, (4) The St. Louis, (5) The America, (6) The Abercron, (7) The United States, (8) The Aujan, (9) The Lotus II.

(Reproduced from "The Scientific American," Nov. 2, 1907.)

Figs. 3 and 4 indicate the difference in the methods of Major Hersey and Mr. Oscar Erbsloch, pilot of the German balloon "Pommern." It is seen that by remaining at the lower altitudes at first Major Hersey followed the tactics by which Lieut. Lahm won the first race.

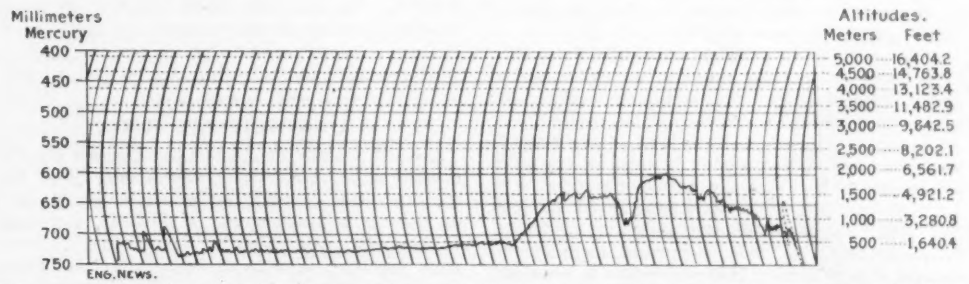


FIG. 2. RECORDING BAROMETER RECORD SHOWING THE TRIP OF THE "UNITED STATES."

Early Oct. 23 the remaining balloons began to descend along the Atlantic coast. First the German "Pommern," bearing Messrs. Oscar Erbsloch and H. H. Clayton was reported at Asbury Park, N. J. Shortly after the French "L'Isle de France," with Messrs. Alfred Le Blanc and M. E. Mix descended not far from the "Pommern," and further to the south the German "Düsseldorf" was reported on the edge of Delaware Bay. Four other contestants stopped still farther south without crossing Chesapeake Bay.

The distances traversed were estimated from data furnished by the United States Geological Survey to the Aero Club of America and the awards have been made only tentatively and subject to the final decision. However, it is not probable that there will be enough change in the records to change the awards already an-

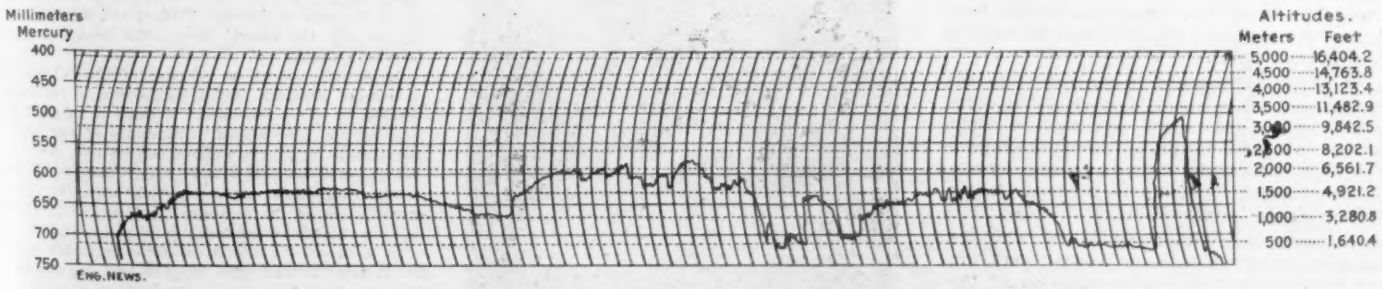


FIG. 3. RECORDING BAROMETER RECORD SHOWING THE TRIP OF THE "POMMERN."

*Some of the statements herein presented are taken from an article in the "Scientific American," Nov. 2, 1907.

nounced. The "Pommern" has been thus tentatively adjudged the winner with a record of 876 mi. "L'Isle de France" traveled 870¾ mi. which is slightly under the record of the "Pommern." However, this French balloon established a record of duration of time aloft of 44 hrs. and 2 min., which is 8 hrs. and 22 min. longer than the record of Count de la Vaulx in his long trip from France to Russia when he established the distance record of 1,193 mi.

The recording barometers carried on each balloon were of the Jules Richard type of modified aneroid constructed so as to register up to 5,000 meters, or about 16,000 ft. altitude. In Figs. 2 and 3 are reproduced the records of the "Pommern" and the "United States" as shown by the original "barograms," but without barometric and other corrections, so that they show only approximately the altitude of the balloons during their flight.

LAYING OUT THE SHEETS OF A LARGE TANK.

[Contributed.]

The writer has been asked the following question by a client: An oil-storage tank, designed for a capacity of 37,000 bbls., is to be made 96 ft. inside diameter and 29 ft. high. There are to be six courses or rings, using 31 plates 5 ft. wide and 10 ft. long for each ring. The bottom ring is to be made of ⅝-in. steel plates. The rings are to be designed so as to fit together with a telescope joint, the top edge of each ring being on the outside of the tank so that all caulking on the outside can be performed by striking downwards. How should the sheets for this tank be laid out so that they will fit together perfectly and require the least amount of labor in erecting the rings?

The method for laying out the sheets for such a tank may be of some interest, as the taper of the rings is so slight that ordinary methods for laying out conical work cannot be applied.

The relative position of any two of the rings is shown in Fig. 1, but with the slope of the lines exaggerated. The smallest inside diameter is 96 ft., and the largest inside diameter 96 ft. plus twice the thickness of the sheet—i. e., 96 ft. ¾-in., or 96¹⁄₁₆ ft. The theoretical form of the sheet for a ring on a conical surface is obtained by extending the side lines until they complete the cone, as shown in Fig. 1. Taking the slant height of the cone for a radius, draw an arc, EH, as shown in Fig. 2; and also draw the arc FG, making the width of the plate A the same as that to be used in the tank. Lay off the arc EH equal in length to the circumference at the large end of the ring, and the length of the arc FG will equal the circumference at the small end.

For small work having considerable slope this method is most convenient. But for the tank in question where the difference in the diameters is only ¾-in. in a height of 5 ft., a short calculation shows that the point A in Fig. 1, where the sides meet, is located about 1½ miles from the ring. It is evident, therefore, as has been said, that the conical method cannot be used in designing large tanks.

The triangulation method is convenient to use for large work where there is considerable slope, but the rings of this tank have such a slight slope that the altitude and hypothenuse of each triangle are practically of the same length. Hence this method could not be used any better than the first one explained.

The following calculations will show why the ordinary standard methods for conical work are useless when applied to the construction of the tank specified in the question: The inner circumference at the large end of the ring is equal to 96¹⁄₁₆ ft. × 3.1416, and at the small end 96 ft. × 3.1416. The difference, in feet, equals ¹⁄₁₆ × 3.1416, which is equivalent to 2.35 ins. As each ring is made up of 31 plates, the difference in length of the two edges on each plate is 2.35 ÷ 31 = .076 in. As a matter of fact, however, the rings should be made slightly larger than the theoretical dimensions, so that they will go together loosely and thus be easily assembled. The small allowance for this would be decided by experience.

If the theoretical camber were doubled, the total per plate would be .076 in. × 2, or not much over ⅛ in. This difference, on a 5-ft. × 10-ft. plate, would be too small to be considered in practice. Therefore, it should be evident from the foregoing explanations that in building a tank of such large dimensions the 5-ft. × 10-ft. rectangular plates would be used without modification, and that the slight camber necessary for the telescope joints between the rings would be made by spreading the top of the rings a small amount when riveting the vertical seams.

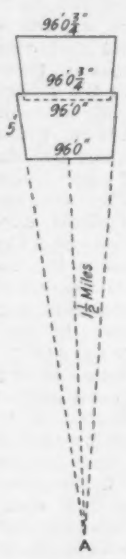


Fig. 1. Elevation of Two Telescopic Rings of a Large Cylindrical Tank, Showing Great Height of Cone if Produced to Apex.

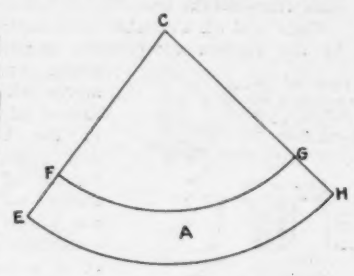


Fig. 2. Theoretical Layout of Sheet for Conic Surface.

A CONCRETE PIPE JOINT.

A novel method of connecting concrete pipe by means of an impervious and strong joint has recently been devised and patented by the firm of Bechtel & Biedendorf, of Fritzlar, Germany. In the many instances in which cast concrete pipe has been used it has generally been found extremely difficult to form a joint which is at once water-tight and strong enough to bear the weight of the superimposed earth, but the present process seems to solve both problems.

The pipes are cast in lengths about 3 ft. in length. The end faces of each pipe are each provided with a groove having a triangular or semi-circular section, this groove being larger at the lower part of the pipe where the thickness is greater. These faces are provided with shoulders, shown in the accompanying figures, to prevent a vertical movement of the pipes when being set. At the crown of the pipes semi-circular openings are provided, which form round holes in the top of the pipe when the two sections are joined. The joint is effected by first putting the adjacent sections together, the shoulders interlocked, and pouring hot asphalt through the circular opening on top until the entire groove is filled with the asphalt. This filling of asphalt rapidly hardens so that in a very short time the earth fill can be replaced in the ditch. The small amount of asphalt which may leak through the inside of the joint may be chipped off as soon as it hardens.

Test on Concrete Pipe Connected with Groove Joint for Pouring Asphalt.

In some recent tests made upon pipe joined in this manner the efficiency of the joint was well proven. When loaded, as shown in the figure, failure occurred by shearing of the concrete in the pipe at the shoulder and not at the asphalt joint. When put under a high water pressure, leakage occurred through the pipe section and not through the joint.

The American agent of the firm is Mr. C. C. Wille, 96 Reade St., New York City.

A PROPOSED GYRATORY SYSTEM OF TRAFFIC MOVEMENT AT STREET INTERSECTIONS.*

By W. NOBLE TWELVETREES, M. Inst. M. E.

It is a well-known fact that the greatest hindrance to vehicular traffic is that due to the compulsory stoppages necessary for permitting the passage of vehicles along intersecting routes, and to the blockages caused by drivers who endeavor to cross comparatively open spaces along the shortest possible lines.

The intermittent stoppage of traffic at street junctions is performed with admirable tact by the police. The duty of regulation is comparatively easy at points where not more than four thoroughfares converge, and less easy where the number of converging streets is more than four. But the process is unavoidably attended with annoying delays, which include the time occupied in checking the movement of one stream of traffic, the interval during which the interesecting line is in movement, and the time consumed in starting and accelerating the speed of the first stream of traffic.

In spaces where traffic converges from several directions there is comparatively little control by the police, drivers being left more or less to their own devices, and allowed to create those tangles which are so obstructive to vehicles and so dangerous to foot passengers.

Proposals were made by various witnesses examined by the Traffic Commission for the construction of bridges and subways with the object of avoiding the intersection of traffic. This solution is one perfectly applicable to junctions of not more than four branches. But to render it satisfactory there must be auxiliary curved thoroughfares providing means of intercommunication between all four streets at a short distance away from the point where one main stream of traffic is carried over the other. The large area of property to be acquired at each crossing of the kind, and the extensive nature of the structural works involved, combine to place the proposal out of court except in positions where, as in the case of Holborn Viaduct and King William St. in the city, the natural levels offer special facilities for overhead traffic.

As an alternative to schemes of this character, the system of gyratory traffic regulations is infinitely preferable for street junctions. It could be adopted at some existing junctions without expenditure of any kind worth considering, at others without serious cost, and throughout the metropolis at a total outlay that would be absolutely insignificant in comparison with the least pretentious among the remedies put forward in the report of the Traffic Commission.

To illustrate the system of gyratory traffic movement, let us take the case of a junction such as that shown in Fig. 1—where four streets converge upon an area sufficient to permit continuous locomotion. To avoid unnecessary complication only one line of traffic in each direction is considered in each street, and the drivers of vehicles are assumed to take the shortest cut to every possible destination. The result is 16 points of conflict leading to hopeless confusion, the only lines free from intersections being those along the outside. A little reflection will show that if vehicles were prevented from

*Slightly condensed from a presidential address before the Civil and Mechanical Engineers' Society of London, England, delivered Oct. 3, 1907. Our text and illustrations are from the London Surveyor for Oct. 4.

penetrating into the central area, where conflict is so pronounced, and were compelled to follow a circular line, there would be no points of intersection. On the contrary, there would be a gyratory procession, receiving and distributing traffic along tangential curves at each of the four branches.

Fig. 2 shows the same hypothetical junction with gyratory traffic regulation, absolutely obviating all points of conflict, and reducing the number of converging and diverging lines from 24 to 16. At the center of the junction is a circular refuge, and at the mouth of each street a refuge, whose sides should be curved sufficiently to act as a training wall, guiding the flow of traffic in the required directions.

Gyratory traffic regulation was first proposed by Mr. Holroyd Smith, M. Inst. Mech. E., M. Inst. E. E., who, some ten years ago, brought the idea before the London County Council, citing Ludgate circus as a place where the system could advantageously be tried, and discussed it with various engineers and others interested in the traffic problem of Paris. Within the last 18 months the notion has been advocated by M. Eugène Hénard, a Parisian architect, by Mr. W. H. Booth, Assoc. M. Am.

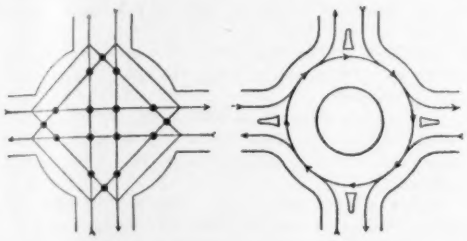


FIG. 1 FIG. 2

Figs. 1 and 2. Ordinary and Gyratory Movements of Traffic at Street Intersections.

Soc. C. E., of Westminster, in a letter to the [London] "Times," and by Mr. Schroeder, of Berlin, in a paper read before the Verein für Eisenbahnkunde.

It must be admitted that a certain amount of intersection must necessarily result from the establishment of concentric circles of gyratory movement. But the difficulty is more apparent than real, because drivers in the outer circuit would very frequently desire to break away tangentially at the same moment as other drivers in the inner circle. Similarly, it may be assumed that arrivals and departures at the several points would be fairly equally balanced, so that the gaps formed in the line would facilitate the entry of newly-arriving vehicles. Any slight drawbacks that might attend the adoption of the gyratory system would certainly be more than counterbalanced by the avoidance of confusion, stoppages and delays; by the additional safety assured to foot passengers, for whom subways should be provided; and by the far smaller number of police officers required for the purposes of regulation.

The proper use of the central areas is to provide halting places for foot passengers choosing to pass through vehicular traffic, and to provide appropriate sites for drinking fountains and public monuments, while in suitable positions they could be planted wth trees or partly converted into gardens. In many places, as already suggested, the central areas would afford admirable sites for underground railway stations, with circular galleries and radiating subways for foot passengers. In other places, again, the central portion of the circular refuge might be excavated and walled round, so that the opening would give light and air to a central hall connected by subways with the foot pavements around the street junction. At the same time, excellent accommodation could be made for lavatories, boot-cleaning and hair-dressing rooms, and other conveniences likely to be of general utility.

MANUFACTURE AND USE OF COPPER-CLAD STEEL.

A means for protecting iron and steel from corrosion by a coating of copper, the union between which and the metal beneath shall be positive and homogeneous, has long been sought by metallurgists. Large sums have been spent in attempting to develop a process for welding steel and copper together.

Protection of steel by copper deposited electrolytically has been tried commercially—in one case by a large American telegraph company, between New York and Boston, without success. The copper coating, upon exposure to severe weather and other conditions, parted company with the steel which it was intended to protect.

Without going in detail into the numerous efforts and experiments that have been made in this direction, we may say that a process has been perfected by a French metallurgist, Mr. J. Ferreol Monnot, and put upon a commercial footing in this country, whereby steel is given a uniform coating of copper of any desired thickness and uniting so positively with the steel that the whole may be rolled, drawn or otherwise shaped without affecting the union. The weld is autogenous, and so firm that co-extension takes place without any discernible separation of the component metals.

The process is one of applying molten copper to the surface of a steel billet or ingot, and letting it solidify there. Mr. Bryon E. Eldred, M. Am. Soc. M. E., who is Secretary-Treasurer of the Duplex Metals Co.*—the company which is manufacturing the product in this country—presented a paper on the subject at a meeting of the Railway Signal Association held at New York on May 14, 1907.

In the discussion of this paper, Mr. Eldred brought out the method by which this is accomplished: briefly, the steel ingot is put into a crucible of molten copper; a sleeve is then lowered around the ingot, with space between the latter and the inner surface of the sleeve; means are provided for holding at the bottom that portion of the molten copper between the ingot and the sleeve, and the whole is drawn out and allowed to cool. In his answer to questions Mr. Eldred said:

Mr. Monnot undoubtedly tried casting, rolling, and almost every other way. In his experiments he discovered that there were critical temperatures heretofore unknown in the working of copper. He found, too, that it was impossible to fuse copper at that critical temperature and surround a steel billet with it; but he conceived the idea of putting the billet in the copper, and with a segregating tube he shut up the steel billet in a mass of molten copper, drew it out, and let it cool.

The billets are cylindrical, and from four to six inches in diameter. From a copper-clad billet of this size, the copper coating being of various predetermined thicknesses, smaller shapes and rods may be rolled; and wire as small as No. 39 B. & S., or finer, may be drawn therefrom, the copper covering drawing out equally with the steel and in substantially its original ratio to the latter.

The photograph shows some sections of the copper-clad steel, in various stages of rolling; the large section at the left is cut from the billet just after withdrawal and cooling and the two smaller sections above it are cut from bars in the intermediate stages of rolling. The manner in which the copper sheath follows the steel bar is clearly brought out in these sections. And, to give an idea of the contrast between the first and last stages in wire-drawing, a coil of No. 26 B. & S. copper-clad wire is also shown in the photograph.

The crescent-shaped piece is a short section cut from a turbine blade for the Westinghouse Machine Co. After comparative tests, that company adopted Monnot copper-clad steel for its turbine blades, in preference to brass, phosphor-bronze, etc. The fibrous texture of copper alone makes it more resistant to erosion by steam than brass or bronze, with consequently less tendency to the deposition of finely divided copper in the boiler tubes and the resulting corrosion of the tubes. [An article treating this subject in detail appeared in Engineering News for April 18, 1907, p. 426.]

To show how firmly the steel and copper have united, saw cuts were made through the copper on the large section here shown, the section was put in a vise, and the portion between the saw cuts heavily hammered. Both the copper and the steel bent, but the weld did not part.

It will probably occur to the reader that the unequal coefficients of expansion of steel and copper might seriously affect the union between the two, particularly in long, thin rods or wires. Concerning this point Mr. Eldred says, in the paper previously mentioned:

It is quite evident that the perfect weld in this instance allows the steel to take up the excessive strain exerted by the copper, and so retard its expansion along the line of contact that the direction of the expansive force is exerted at right angles to the line of union, increasing the diameter of a wire, for example, rather than its length. The elongation of a Monnot copper-clad wire due to expansion is, I find, about equal to that of steel under similar conditions.

In its application to wire for electrical transmission purposes, and telephone and telegraph use, Monnot wire has perhaps its widest field of utility. Quoting further from Mr. Eldred's paper:

A coating of any predetermined proportion to the core is effected, thereby securing such conductivity as may be desired, coupled with the necessary tensile strength, at minimum metal expense. The wire is cheaper than copper, and material economies are effected in its use; especially where copper is employed in excess of the necessary transmission requirements of the conductor, for the purpose of increasing tensile strength.

A non-oxidizable surface is presented, which, being rolled and drawn against a backing of steel, is non-porous and presents peculiarly advantageous wearing qualities where strength lies in surface skin. The wire, unlike hard-drawn copper, affords a material not readily broken, and which need not be handled with the same care by linemen. In fact, the copper-clad wire possesses such properties that it may be re-strung after being taken down, whereas copper would necessarily have to be scrapped.

As an example of the superior properties of Monnot copper-clad steel wire, the result of an average of six tests with a No. 26 B. & S. soft-annealed wire composed of 25% copper and 75% by weight of mild steel of approximately nine points carbon, showed an average breaking weight of 12½ lbs., corresponding to 58,000 lbs. per sq. in., or about twice that of soft annealed copper. Torsion tests of 6-in. lengths average 461 twists, while one sample showed the remarkable property of breaking only after 650 revolutions of the machine had been recorded. An elongation test of this sample showed 31% elongation of a test piece 24 ins. long.

In the case of wire for telephone transmission, where the magnitude of the currents is so small as to cut no figure in the determination of the size used but where the size depends upon length of span and corresponding tensile strain, the copper-clad wire may be used with very great saving. Investigation of Monnot wire on behalf of the American Bell Telephone interests was made by Mr. S. P. Grace, Assoc. Am. Inst. E. E., Chief Engineer of the Central District & Printing Telegraph Co.—the Bell telephone organization of Pittsburg. Mr. Grace made tests on numbers of samples, and his report* in part has the following to say:

Some of the samples were broken by tension, and the fractures examined under a powerful microscope; all surfaces of cleavage were found to cross the surface of contact between the iron and copper. Samples were also broken by repeated bendings, and the broken edges examined under the microscope; in this case the surfaces of cleavage were found to cross the surface of contact between the iron and copper. In no case was any cleavage obtained along the surfaces between the iron and copper. Heating the wire to a red heat and plunging in cold water did not seem to affect the weld between the copper and the steel.

Some of the 18-gage wire which we tested had a tensile strength of 198 lbs., while in the 17-gage wire 210 lbs. was easily reached. The conductivity of these samples was about 30%; but it is possible to get wire of a conductivity of 40% to 50% by increasing the thickness of the copper covering, which, however, reduces the tensile strength. It was also found that twisting, nicking, scratching and bending the wire were not nearly as injurious as similar treatment of hard-drawn copper wire. The reason for this is easily seen, as the main strength of the wire resides in the steel core and not in a thin outside skin, as is the case with hard-drawn copper wire. It was also noticed that in cutting this wire with pliers, the copper was drawn down over the exposed steel end, almost completely covering it. After making a thorough examination of this wire its properties seemed so remarkably well suited for distributing wire that it was almost evident at once that it would prove invaluable for this purpose.

In attempting to pick out the most suitable size of copper-clad wire, it was found that a No. 18 B. & S. would undoubtedly do the work as well as a No. 14 B. & S. copper wire. Its factor of safety, under all conditions of load, was found to be considerably better than the No. 14 hard-drawn copper wire; however, its conductivity would only be as good as a No. 23 or No. 24 copper wire. We finally decided to use No. 17 B. & S. copper-clad wire having a tensile strength, after being tinned, of at least 190 lbs., and a resistance of not over 100 ohms per single mile at 60° F.

The bare No. 17 copper-clad wire, per mile (double),

*298 Fifth Ave., New York; factory, Chester, Pa.

*Report dated Sept. 26, 1907; tests made in June, 1906.

will weigh 29 lbs., against 65 lbs. for the No. 14 hard-drawn copper. This represents a considerable saving, since the copper wire would cost 21 cts. per lb., while the copper-clad wire costs but 17 cts.

Mr. Grace's report goes on to state the total estimated saving to the Bell companies in the United States, figures of great interest but which limited space prevents our giving here further than that the estimated saving for all Bell companies, in distributing wire alone, would be about $450,000 in a year if No. 17 Monnot wire were substituted for No. 14 hard-drawn copper.

Consideration of these figures in terms of larger power-transmission enterprises may readily be made by the reader. It will occur very forcibly that, for high-tension transmission work, where great current-carrying capacity is not necessary, but where high tensile strength for long spans and small surface exposed to wind stresses are requisite, the new wire will prove available where aluminum cables now are used.

Some of the properties of copper, aluminum and Monnot wire for conductors are given approximately in the following table. The figures are for hard-drawn conductors; aluminum is of course used stranded.

Wire.	Weight per 1,000 Ft. No. 0.	Tens. Str., No. 0.	Conductivity.	Approx. Price per 1,000 ft.†
Copper	320 lbs.	3,700 lbs.	100	$52.00
Aluminum	97 "	2,500 "	60	29.00
Monnot, Grade "A"*	288 "	6,800 "	30	42.00

*25% copper, 75% steel.
†Present market prices.

Comparison of these figures will bring out the strong point of the Monnot wire, in its relatively great tensile strength and by no means low conductivity—that of steel alone being but 14%.

Some comparisons of interest, between No. 17 B. & S. copper-clad wire, Grade "A," and No. 14 B. & S. copper wire, are given in the following table—made up of excerpts from a table in Mr. Eldred's paper; the figures are based on tests made by the American Telephone & Telegraph Co.:

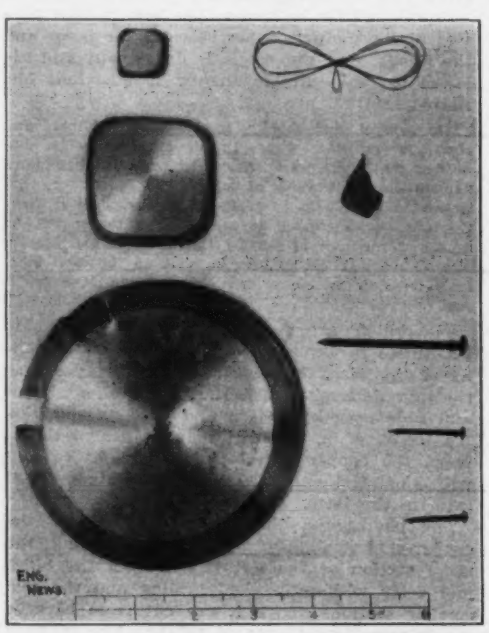
	No. 17, Monnot.	No. 14, Copper.
Diameter, inch	0.0453	0.064
Area, circular mils	2025	4096
Area, sq. in.	0.00162	0.00322
Breaking weight, lbs.	210	190
Weight per 1,000 ft., lbs.	5.5	12.4
Weight per mile, lbs.	29	65
Resistance per 1,000 ft., ohms..	16.76	2.49

Corrosion tests were made upon samples of Monnot wire by Mr. H. M. Huxley, Assistant General Manager of the Duplex Metals Co. A length of No. 28 wire was immersed for one week in a 0.2% solution of sulphuric acid, the ends of the wire not being in the liquid; a length of No. 26 hard-drawn steel wire was exposed for the same interval to a solution of the same strength. At the end of the week the solution in which the steel had been contained no free acid, and the steel wire was completely disintegrated. The solution in which the Monnot wire had been still showed 0.1% of free acid, and the wire was in excellent condition and showed no signs of acid brittleness; no trace of iron was found in the solution. Nails made from copper-clad wire, which showed small spots of exposed steel at head and point, were subjected to 0.5% and to 5% acid solutions; some corrosion occurred at the ends, but not enough seriously to affect the strength of the nails. Some of these copper-clad nails are shown in the photograph; their utility in places exposed to corrosive influences will be evident.

As to the comparative cost of Monnot wire and copper wire, Mr. Eldred gives some figures, based upon overhead construction practice in signal engineering, illustrative of the saving obtained by the use of the former:

I understand that it is considered good practice by signal engineers to use No. 10 B. & S. gage copper for overhead construction, either bare or in double or triple braid, while in five and seven pair cable No. 14 B. & S. gage copper is considered the standard of practice. It would thus appear that the conductivity of No. 14 B. & S. gage copper satisfies the electrical requirements, while the tensile strength of a No. 10 B. & S. wire is desired. In other words, the erection of No. 10 B. & S. copper lines in overhead construction necessitates the use of 32 lbs. of copper for each 1,000 ft. to secure required tensile strength. At present prices (May 14, 1907) the copper for such a line costs $8.77 per 1,000 ft. Consider a No. 11 B. & S., 50%-conductivity (grade "C") copper-clad wire to displace the No. 10 pure copper. The No. 11 copper-clad wire affords the required conductivity, while its breaking weight is greater by 156 lbs. The weight per 1,000 ft. is less by 8.7 lbs., and the safety factor is greater. The cost per 1,000 ft. of such a high-conductivity copper-clad wire would be $6.78, showing a saving in metal cost alone of $1.99 per 1,000 ft. in favor of the copper-clad wire, not to mention the other attendant advantages in cost of stringing such a lighter, stronger, more durable wire, and the allowance of much longer spans.

I am inclined to think that in most instances signal engineers will prefer to use Grade "A," 30%-conductivity, copper-clad wire, operating with greater electrical resistance but allowing of the use of a much smaller conductor of higher tensile strength. Where possible to make such applications of copper-clad wire, a No. 13 B. & S. gage Grade "A" wire with electrical resistance at 60° F. of 6.543 ohms, and breaking weight of 488 lbs., affords a considerably greater safety factor than No. 10 B. & S. gage copper. Such a copper-clad wire weighs but 14 lbs. per 1,000 ft., and costs less per lb. than Grade "C" metal; so that to-day's prices



Monnot Copper-Clad Steel in Various Stages of Rolling, and Parts Made From It.

In the nails shown the copper covering flows over the heads in the upsetting operation, almost completely covering the steel. They drive as readily as ordinary steel nails.

per 1,000 ft. would be $3.44, or a saving over No. 10 B. & S. gage copper of $5.58 per 1,000 ft., or a metal cost saving over pure copper now used in open line construction of nearly 60%.

It should be mentioned here, in connection with the foregoing notes, that the manufacturers make the Monnot wire in three grades, "A," "B" and "C"—"A" with a conductivity of 30% that of pure copper, and an average tensile strength of 115,000 lbs. per sq. in.; "B" with 40% and 105,000 lbs. as the corresponding figures; and "C" with 50% and 95,000 lbs.

U. S. CIVIL SERVICE EXAMINATION QUESTIONS FOR POSITION OF IRRIGATION ENGINEER.

By "COMPETITOR."

The following examination was given by the U. S. Civil Service Commission for Irrigation Engineer, on Oct. 16 and 17, 1907. From the available list thus secured applicants are appointed to the positions of engineer, assistant engineer, and hydrographic aid, according to the experience of the candidates. The salaries range from $1,000 to $2,000 and upward. The first three subjects are given on the first day, and the remaining subjects on the second day. The "Manual" describes the examination as follows:

Mathematics, pure and applied; algebra, including problems involving quadratics; plane and solid geometry; plane trigonometry; and elementary problems in applied mechanics—10.

Topographic Sketching and Lettering.—Competitor must show ability to make intelligible drawings of engineering and topographic features—10; general surveying, topographic, hydrographic, and United States theory and practice as covered in Manual of General Land Office and first-class surveying text-books—15.

Engineering and Hydrographic Construction.—Questions to illustrate the general practice used on works both on land and in water, including strength of materials and specifications for same—20; *Discussion of Engineering and Hydrographic Data*: the preparation of brief papers on various practical hydrographic problems connected with irrigation, power, water supply, sanitary engineering, etc.—15.

Training and Experience—30.

The questions asked, as given below, are not exact, as they were written down from memory afterwards:

(1) MATHEMATICS.—Estimated time, 2 hours. 4 out of 5.

(1) Two circles of 5 and 10-ft. radius are tangent to each other and to a straight line. Find area between line and circles.

(2) A rectangular field contains one acre. Two boys start from one corner and run in opposite directions, meeting 39 ft. from the opposite corner. One runs 5-6ths as fast as the other. Find dimensions of field.

(3) Two chords of a circle intersect. Prove that they are reciprocally proportional. (Give complete proof.)

(4) A flag pole on a cliff is 40 ft. high. The angles from the plain below to the top and bottom, respectively, are 45° and 30°. Find height of cliff.

(5) A simple beam 6 ft. long, 6 ins. deep and 4 ins. broad is loaded with a variable load decreasing rectilinearly from 200 lbs. at outsides to 0 at middle. Weight of beam is 40 lbs. per cu. ft. Find shear, maximum bending moment and stress in wood.

(2) SURVEYING.—Estimated time, 2 hours.

(1) Find area of field, and error of closure of field (6 sides with their lengths and bearing were given).

(2) Give complete notes relative to the establishment of a fictitious gaging station for current-meter work.

(3) Explain method of cross-sectioning and setting out slope stakes for proposed railroad or canal.

(3) TOPOGRAPHICAL DRAWING.—Estimated time, 3 hours.

A map with elevations on it was given, and a complete topographic map had to be made with 5-ft. contours, putting in railways, highways, etc.

(4) ENGINEERING CONSTRUCTION.—Estimated time, 4 hours. 3 out of 4.

(1) For ordinary structural steel what ultimate tensile strength, elastic limit, percentage of elongation and capability of bending cold would you specify?

(2) Design a reinforced concrete retaining wall to hold up a bank of earth level on top, 8 ft. high, exposed to ordinary weather conditions. Give all computations.

(3) Give a brief specification for an earth embankment on an earth foundation to resist a head of 30 ft.

(4) A concrete rubble dam is to be built across a stream 100 ft. wide and 1 ft. deep, with low water flow of 200 sec.-ft. State essential machinery and outline method of conducting work.

(5) ENGINEERING AND HYDROGRAPHIC DATA.—Estimated time, 3 hours. 4 out of 5.

(1) State and explain briefly all steps in the complete development of an irrigation project from an engineering standpoint.

(2) State determining factors in choice of earth, rock fill or masonry dam.

(3) What hydrographic data should an engineer endeavor to get in determining the value of a small river for water power?

(4) Of what two essential elements is cast iron composed? What four common so-called "impurities" are often present? What is the chemical difference between cast iron, wrought iron and steel?

(5) What is the ultimate tensile strength of grey cast iron, wrought iron and mild steel? What factor of safety is commonly used to reduce ultimate strength to working strength?

TRAINING AND EXPERIENCE.—This is rated on the statements given in the sworn application form (1312).

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The epidemic of serious railway accidents which prevailed during the latter part of 1906 and the first months of 1907 has led every one to expect that the figures covering these casualties would exceed all previous records. The statistics for the year ending June 30, 1907, were made public by the Interstate Commerce Commission last week, and the expectation has been realized. The casualties in railway accidents for the year were 5,000 persons killed and 76,286 injured. This is an enormous and appalling increase over the figures for the preceding year, although the record of that year was considered at the time exceedingly bad. The figures for this increase are 775 more persons killed and 9,577 persons injured. It is possible that some part of the increase in the number of injured may be due to greater care in furnishing reports of accidents and the inclusion of a larger number of persons with minor injuries. But the increase in the number killed undoubtedly represents an actual increase in the risk of travel by rail. The above figures include only accidents to passengers and to employees while actually on duty on or about trains. The casualties to trespassers on railway property and those due to accidents at grade crossings and accidents in railway shops are all excluded. The list includes, also, only the steam railways reporting to the Interstate Commerce Commission, and does not include therefore the great mileage of electric lines, on which casualties are now increasing at such a rapid rate. It is probable that these figures will command the attention of Congress at the approaching session, and that renewed efforts will be made to bring about further Government action in the investigation by experts of railway disasters and of safety appliances designed for their prevention.

Regulation of street traffic is a problem confronting very large cities, and one that heretofore has received comparatively little attention in America. Elsewhere in this issue we print an abstract of a paper on traffic regulation in London, where, as many of our readers know, the congestion of traffic is very great, and rigid measures of public control were absolutely necessary and have been long in force. The author of this paper suggests that at street intersections the traffic, instead of being stopped first on one street and then on the other or cross street, be directed in a circle, thus leaving a free central refuge for pedestrians and making the stream of traffic continuous, with turnouts from the circle at the proper points. The scheme is illustrated by diagrams, to which reference may be made for a clearer understanding of it.

This gyratory system, as Mr. Twelvetrees calls it, is certainly worthy of consideration, but it seems questionable whether the author of the paper has taken into full consideration the difficulties involved where provision must be made for double lines of street-cars on each street. We hardly think he would go so far as to propose that the street-car lines should adopt the gyratory system. If they did not, of course, the central refuge space would be lost, and, although the stream of vehicular traffic might pursue a fairly continuous circular course at the intersection, so far as interference between ordinary vehicles was concerned, yet obviously it would still be necessary for the vehicular traffic to be stopped and for the street-cars to be stopped at intervals, as is at present done in New York and in other American cities. Very few American cities, it may be noted, have their street intersections laid out so as to give a circular space or "circus," as many of these street intersections in London are called. The plan seems to have decided merits where the street intersections are so laid out as to facilitate its adoption and where there is no street-car traffic to be provided for. It might well be kept in mind, in those cities where broad studies of municipal improvements, including changes in street plan to facilitate traffic movement, are being made. Quite regardless of any gyratory system of traffic movement, the circular spaces at street intersections and the central refuges have advantages that would warrant their adoption in American cities as opportunity affords, as they already have been widely adopted abroad.

SOME OF THE BROADER ASPECTS OF FLOOD PREVENTION.

Altogether too little attention has been given to flood prevention problems in this country, and most of what has been done has been local in character. The time seems to be ripe for a much broader study of the subject that has yet been given to it.

The foregoing remarks have been prompted, in part, by a paper and an extended discussion published in the "Proceedings of the Engineers' Society of Western Pennsylvania" for July and October, 1907. The paper was presented by Col. T. P. Roberts, and the discussion was participated in by a large number of Pittsburg engineers. Primarily, the paper dealt with the need of either flood protection or flood prevention at Pittsburg, which need was brought forcibly to public attention by the floods that occurred there in March, 1907. After reviewing briefly some of the possibilities for flood control by reforestation of drainage areas and by storage in large reservoirs—neither of which the author seemed to think applicable to Pittsburg conditions—Colonel Roberts outlined a plan for protecting the business section of Pittsburg from floods by building a wall on the Allegheny and Monogahela River frontages of the city for some distance up from the junction point of the two rivers. He suggested that in order to prevent flooding of cellars by percolation, the walls should be carried down for some distance below the street surface. In the discussion that followed the paper, nearly every phase of the subject of flood prevention was touched upon, some points being merely mentioned and others discussed at length. Some of the discussion, appropriately enough, was quite local in character, and some of it entered upon the broader aspects of flood prevention. Mr. Morris Knowles, M. Am. Soc. C. E., Chief Engineer of the Bureau of Filtration, Pittsburg, dwelt particularly upon the desirability of considering more than the purely local matter of protecting only a part of Pittsburg against floods. He also called attention to the fact that flood prevention measures are or may be of far greater significance than flood prevention alone, related as they may be to water supply for cities, for irrigation, for water power and for navigation, and to the equalization of the flow of streams in such a way as to lessen or obviate the nuisance from sewage pollution which may occur where it is necessary to discharge sewage into streams.

We shall not here attempt to follow the discussion before the society named, although we take pleasure in recommending the paper and its discussion to those interested in flood protection and prevention. Some general consideration of the subject in its broader aspects seems desirable.

A few people, but as yet altogether too few, are beginning to realize more or less vaguely the great possible value of the water resources of the country and the importance of conserving and utilizing them to the best advantage. Our municipalities are compelled to go farther and farther afield for water supply, and to depend more and more upon storage. At the same time, they are finding it more and more difficult to dispose of their sewage without injury to themselves or to their neighbors. The difficulties of sewage disposal are greatly increased by the low stream flow that takes place in the summer, and particularly in very dry seasons. The possibilities of unobjectionable sewage disposal by dilution would be increased if excessive stream flows could be held back until times of scanty rainfall. The possible water-power resources of the country are only beginning to be developed, and these would be greatly augmented in many districts if water could be stored in considerable quantities at times when it would otherwise go to waste. The recent overtaxing of the railways has led many people to think that recourse must be had to waterways for means to move the vast volumes of freight resulting from our many and varied industrial activities. A more equable distribution of stream flow throughout the year, if this could only be provided by storage, would be of obvious advantage to navigation interests. Vast areas of land in the West await only water to be made highly productive, and the further provision of the immense volumes of water, which would be quickly seized upon if only available, is dependent very largely upon a great increase in storage facilities.

Besides the value and main great uses of the water resources of the country, it should be remembered that the unbridled discharge of streams great and small is annually wiping out immense values, through the erosion of land, particularly in the South, and through robbing the land everywhere of the fertile top soil which Nature has accumulated and stored through decades or centuries. Closely associated with these matters is the vexed subject of the relation of deforestation and reforestation to water and top-soil conservation and to flood prevention. Many of the contradictory statements as to the relation between forests and their absence and floods is due, as Mr. Knowles suggested in his discussion of Col. Roberts' paper, to a lack of data bearing on changes in forest areas, seasonal rainfalls, etc., during the past fifty years.

It needs only so brief a résumé as has just been given, to indicate that flood prevention, when considered in connection with the conservation and utilization of the water resources of the country, deserves most careful study. It is a subject of national importance, that may well be given the best thought that can be put upon it by all who are in a position to aid in solving the many problems presented. The Inland Waterways Commission, to which more extended reference is made at the close of this article, will doubtless give much attention to this subject; certainly as regards the country as a whole, and possibly as relates to at least some of the large and important streams; for instance, the Ohio River below and the Allegheny and Monongahela rivers above Pittsburg. The several States might very properly take up relatively minor but still large and important drainage areas, as has already been done, for example in

a fairly comprehensive way by the Passaic River Flood Prevention Commission. Opportunities for investigations still more local in their nature will occur to many of our readers.

Of course flood prevention is not an issue in connection with all streams, but some or all of the other problems relating to the conservation and equalization of stream flow and to the utilization of every drop of water to the best advantage will be worthy of consideration, sooner or later, in connection with every stream in the country. Where flood prevention is not an issue, the other problems that present themselves may be all the more readily solved, since they will not be complicated by the necessity of entering upon flood prevention measures.

The conservation and utilization of our water resources, whether or not flood prevention is involved, should always have as its aim the greatest good for the greatest number. An attempt should of course be made to distribute the cost of storage or protection works according to the benefits received. No source of revenue should be overlooked. In particular, the possibilities of developing water power in connection with water storage, whether that storage be for flood protection, irrigation, municipal water supply, or navigation, should be carefully studied. Such revenues as can be derived from the development of water power or other utilization of water resources should accrue to the public, and, as a rule, should be used to reduce the cost of constructing and operating whatever works may be involved for water storage or other purposes, instead of being left to be gobbled up by private interests, as has hitherto generally been the case when anything has been attempted. Where water-power developments in connection with public water storage are left to private interests there is always a danger that, in the construction and operation of works, the interest of private corporations will be put far above that of the public, and that the main object of the storage or the protection works will be sacrificed.

Of course conditions may sometimes make recourse to private enterprise necessary for the development of subsidiary revenue-producing enterprises. If so, full and intelligent public control of such enterprises, with publicity of financial and physical records, should be made sure of.

Two other points deserve mention: The first is that flood *protection* is often confused with flood *prevention*. Flood protection is not only local in its effect but it also militates against the wider interests involved, both in so far as those interests relate to the protection of other localities from floods and as regards such benefits as accrue to water supply and power, navigation and irrigation, where storage is provided for the prevention or lessening of floods.

The other point which should be mentioned, and it is a very important one, is the relation between channel obstructions and floods. Mr. Willis Whited stated, in the Pittsburg discussion already mentioned, that at the South Tenth St. Bridge (Pittsburg) the river channel at "full pool" is now only some 700 ft. in width, as compared with about 1,300 ft. when the old bridge was built, fifty years ago. River obstructions by the direct encroachments of man, and also by indirect means, such as the filling of stream channels with dirt eroded in greater quantities after defofestation, should be given a prominent place in any study of either flood protection or flood prevention.

Lest any of our readers should conclude from our reference, above, that we expect too much from the Inland Waterways Commission, we would call attention to the fact that the Commission was not created to deal solely with the improvement of rivers for navigation. President Roosevelt's letter appointing the members of the Commission (see Eng. News, March 21, 1907) stated with clearness and emphasis that in formulating plans the Commission would be expected to consider every phase of both stream control and water utilization. He specifically mentioned flood prevention from various points of view, forestry problems, water power and irrigation. He said that the time had "come for merging local projects and uses of the inland waters in a comprehensive plan designed for the benefit of the entire country," and that "such a plan should consider and include all the uses to which streams may be put, and should bring together and coordinate the points of view of all users of water." He also said that any plan adopted "should recognize the means for executing it already in existence, both in the Federal Departments of War, Interior, Agriculture, and Commerce and Labor, and in the States and their subdivisions." Recognizing the complexity of the problems involved, President Roosevelt stated that when the work of the Commission, as then appointed, should be sufficiently advanced he should add to it "certain consulting members." Altogether, the document from which we have been quoting showed a remarkable grasp of the whole matter of stream control and utilization. We wonder that in the very lengthy Pittsburg discussion to which we referred at the beginning of this article no one mentioned the Inland Waterways Commission or the work submitted to it by President Roosevelt.

In conclusion, we suggest that the engineering societies of the whole country—local, state and national—might profitably discuss at length the whole subject of flood prevention, water conservation and utilization, using the President's letter as a starting point.

LETTERS TO THE EDITOR.

Designing Reinforced-Concrete Beams and Slabs on the Cantilever Principle.

Sir: The peculiar phenomena incident to the failure of reinforced-concrete beams subject to impact, as described in your issue of Oct. 24, in a reprint of Prof. Hatt's paper "The Effect of the Time Element in Loading Reinforced-Concrete Beams," is an added reason for using the cantilever type of design, as far as possible, in reinforced-concrete beam work. A previous letter from the writer ["The Effect of Continuity on the Design of Reinforced-Concrete Beams and Slabs," Eng. News, Nov. 29, 1906] gave several other reasons, in answer to an inquiry of one of your readers, and mention is now made of this added reason so as again to call attention to a subject which is believed by the writer to be one of the greatest importance, ignoring which has been the real cause of numerous failures.

Yours truly,

E. P. Goodrich.

1170 Broadway, New York City, Oct. 31, 1907.

The Coming Cement Age!

Sir: In your issue of Oct. 31 I read with interest the extract from the "New York World" describing Mr. Thomas A. Edison's achievement in designing concrete dwellings. I am struck with admiration at the off-hand way in which a great mind brushes aside the many perplexities that trouble the ordinary designer of concrete buildings. The casting of plumbing fixtures and plumbing pipes in place is certainly a startling idea; but if this can be accomplished, why not carry the idea further, and have the necessary furniture cast in place; dishes may be cast on the dining-room table, and arranged with flushing rims and wastes like the plumbing fixtures, so that the trouble of dish washing may be done away with forever.

When thinking along this line one's ideas expand so rapidly as to cause hesitation in presenting them, but it seems to the writer that if the householder's sensibilities are so blunted as to make him willing to occupy a cement dwelling which is precisely like thirty thousand others, presumably in the same town, he would almost be ready to consider cement napkins and cement bedding.

Trusting that these suggestions may possibly be of some help in the development of the wonderful idea, I am,

Yours truly,

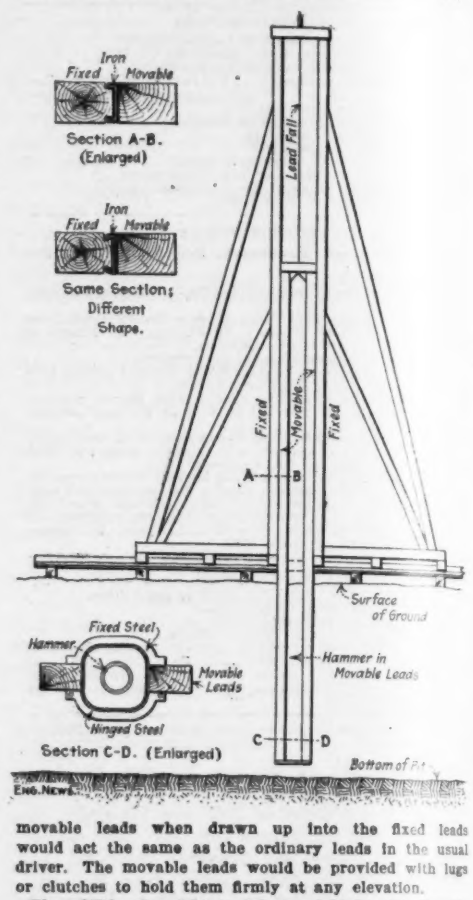
Geo. V. Rhines.

1234 Ohio Building, Toledo, Ohio, Nov. 4, 1907.

Telescoping Leads for Pile-Drivers.

Sir: I would like to know if any of your readers have used a pile-driver arranged as shown by the accompanying sketch. The idea is to use a set of movable leads within the fixed leads, the movable leads doing away with the usual extension leads, and, also, doing away with the cumbersome "follower." By firm steel braces at the top of the movable leads, and by the use of channel-iron guides as shown by two sections at A-B, and by steel braces at the bottom of the movable leads, the hammer (steam hammer) with hose of sufficient length, could work to advantage, delivering direct blows at a depth of at least 25 ft. below the surface of the ground. The pile, of course, would require the usual steadying with the head line, etc.

By using a three-drum engine the pile fall, hammer fall and lead fall might be used independently. The



movable leads when drawn up into the fixed leads would act the same as the ordinary leads in the usual driver. The movable leads would be provided with lugs or clutches to hold them firmly at any elevation.

The additional weight to driver might be objectionable to some, but I think that this weight even with the extra weight of three-drum engine would do nothing more than lower the center of gravity of the machine.

The ordinary pile fall might be used to manipulate the movable leads, but this arrangement would be less convenient than having independent falls.

Respectfully yours,

H. P. Shoemaker.

171 11th St., Long Island City, N. Y., Oct. 12, 1907.

Balanced Gate Valves at the Wachusett Dam.

Sir: The writer was much interested in the type of balanced gate valve designed by Mr. John Peterson, and illustrated in Engineering News for Oct. 17, as it recalled to his mind a valve of similar type designed by the late Reuben Shirreffs, M. Am. Soc. C. E. The writer was one of Mr. Shirreffs' assistants while Mr. Shirreffs was Principal Office Assistant on the staff of Mr. F. P. Stearns, former Chief Engineer of the Metropolitan Water Works in Boston.

Mr. Shirreffs was in charge of the preliminary studies and designs for the Wachusett Dam (at that time known as the Nashua Dam), and in the course of discussion one day the question of outlet valves came up. Mr. Shirreffs remarked that he had long had in mind a type of balanced valve which, under considerable head, he considered far superior to the ordinary sluice-gate or gate valve, on account of ease of operation; and he then produced a sketch of the valve which he had in mind.

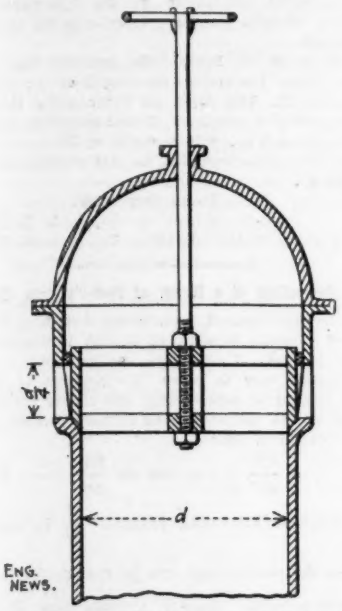
With Mr. Shirreffs' permission the writer that evening made a rough sketch of the valve, an exact copy of which is herewith enclosed; but no attempt was made to show working details, the sketch being made simply for future reference.

The writer is unable to state the exact date on which the sketch was made, as unfortunately the note book in which the sketch was filed passed through a fire some years ago and the upper part of the sheet with the date was burned off; it was, however, later than November, 1895, and prior to August, 1897, and to the best of his recollection it was in the fall of 1896.

It will be seen that the valve designed by Mr. Shirreffs is practically the same as the first one designed by Mr. Peterson. The writer has referred to the sketch of Mr. Shirreffs' balanced valve several times, but has

never had occasion to use the design for a tight-closing valve.

The principle of the balanced piston, however, has been used to the writer's knowledge a number of times and was embodied in one of the inlet-regulating valves for one of the filters in the Lower Roxborough Filter Plant at Philadelphia, and also in one of the effluent-regulating valves designed for the Torresdale Filter Plant at Philadelphia. It is also in use in the filter controllers of the filtration plant of the Hackensack Water Co., at New



Sketch of Balanced Gate Valve Designed by the Late Mr. Reuben Shirreffs.

This sketch was made only as a reference sketch, and no working details—ports, etc.—are shown.

Milford, N. J., and is also embodied in the filter and wash-water controllers for the water-purification works now under construction in Columbus, Ohio.

The writer has felt indebted a number of times to Mr. Shirreffs for the idea of using a balanced piston, and it is with no desire in the least to question the originality of Mr. Peterson's design that this is written, but rather to give proper credit to one now passed away but well remembered by many friends who were formerly associated with him.

John H. Gregory.

Engineer in Charge of Water and Sewage Works, Board of Public Service.

Columbus, Ohio, Oct. 23, 1907.

The Strength of Corrugated Sheeting.

Sir: In your reply to Mr. F. L. Burr, in your issue of Oct. 24, 1907, you overlooked the experiments on the strength of corrugated steel, by Ralph H. Gage, at the University of Illinois. Complete details of these experiments are published in "Technograph," No. 17, and a summary of the experiments is published in the writer's "The Design of Steel Mill Buildings," together with other data on corrugated steel. The form of the formula given in Carnegie's "Pocket Companion" is correct, but the constant is very much in error. It might be of interest in this connection to know that Mr. Gage's tests were the first experiments made since 1869, when some tests were made in India.

Very truly,

M. S. Ketchum,

Dean of College of Engineering, University of Colorado.

Boulder, Colo., Oct. 29, 1907.

Sir: In reply to the query of Mr. F. L. Burr in your issue of Oct. 24, concerning the strength of corrugated steel, I would refer him to Ketchum's "Steel Mill Buildings," where, on p. 230 (Ed. 1906), is given the following formula based on Rankine, for corrugated steel supported as a simple beam, with 2½-in. corrugations:

$$W = \frac{4}{15} \cdot \frac{Shbt}{l}$$

where

W = safe load in pounds, total,
S = working stress in pounds per square inch
h = depth of corrugations in inches—the standard is ⅝ inch
b = width of sheet in inches—the standard is 27½ inches after rolling.
t = thickness of sheet in inches—$^3/_{16}$-in. to $^5/_{16}$-in.
l = clear span in inches.

On the same page is graphically the safe load per square foot for varying spans and gages based on the standard distance of 2½ ins. center to center of corrugations.

Also on page 231 is given the result of a series of tests made by his assistant, Mr. Ralph H. Gage, from which he deduces the formula

$$W = \frac{CSh^2bt}{l}$$

the coefficient C depending on the angle the metal makes with the horizontal, it being 0.278 for an inclination of 30°, 0.293 for 45°, 0.312 for 60° and 0.393 for 90°. This formula agrees closely with the tests made.

Very truly yours,

Thos. C. J. Baily, Jr., M. Am. Soc. C. E.

11th and O Sts., S. E., Washington, D. C., Oct. 26, 1907.

Disjointing Cast Iron Water Mains.

Sir: Under the heading of "Disjointing Cast Iron Water Mains," you gave, in your issue of Oct. 10, 1907, the substance of a discussion on that subject at the annual convention of the Central States Water-Works Association, held at Wheeling, W. Va., in September, 1907. The subject is so very interesting that I am induced to contribute a few notes descriptive of some work of that class done by me.

In carrying out a scheme of improvements to the water supply of St. John's, Newfoundland, the following work had to be done:

(1) Build a concrete conduit 3,140 ft. in length to replace a line of 24-in. pipe that was laid through a rock cutting at a depth of from 10 to 32 ft.; the 24-in. pipes to be taken up and relaid.

(2) Build a 42-in. concrete conduit, 8,000 ft. in length, to replace two lines of 16-in. pipe; also to be taken up and relaid, with the 24-in. pipes as a duplicate supply main.

The walls of No. 1 conduit were built on either side of the 24-in. main. They were 7 ft. in height, and 4 ft. face to face. After the concrete side walls were finished, the 24-in. pipes were taken up, while the water supplying the city was running through the line formed by them.

No. 2 conduit, 42 ins. in diameter, and a compensating basin at the outer or city end, 60 × 120 × 14 ft., and a gate and screen house at inner end, were first built. This conduit was located about 10 ft. from the two lines of 16-in. pipes.

When No. 2 conduit and the walls of No. 1 conduit were finished, we commenced to take up the 24-in. pipes. At the outer end, where the 24-in. line joined the two lines of 16-in. pipes, a piece about 1 ft. in length was cut nearly through with ordinary cutting tools. The water was then shut off for an hour for the final cutting and breaking out of the piece of pipe.

After this was done, the water was again turned on, and the work of lifting and relaying the 24-in. main and arching the No. 2 conduit was done without any further interruption of the supply.

The method of lifting the 24-in. pipes was as follows: Three tripods or shears were spaced a pipe's length apart; three chain straps were passed under the centers of three pipes, and the outer end lifted up to a height of 3 or 4 ft. Blocks of timber were then swung under each uplifted hub, and the falls let go suddenly, resulting, after considerable trouble and manipulation of the falls and levers, in disjointing one, two, or more pipes. The disjointed ones were then hoisted up on the top of the walls, removed by car-track to a suitable position, hoisted out by engine and derrick, and the remaining lead joints were then burned out.

In taking up the lines of 16-in. mains we had no water to contend with, as the flow was then diverted into No. 2 conduit. After unbolting at the hatch box, and lifting it out of the cut, a pipe *reversed* was slung from a tripod and used as a battering ram. This was found to be a very rapid and altogether satisfactory method of disjointing the pipes, as a few punches of the improvised battering ram against the hub of the pipe were sufficient to drive the socket clear of the spigot. The ring of lead generally dropped off the end. I found that it was not necessary to clear out the trench down to the bottom of the pipes, as the ram worked better when there was some of the earth left by the sides, as it formed a sort of bond to keep the pipes from swaying while being driven out. If the pipes are of a brittle nature, a saddle can be used to prevent damaging the faucets.

Two shear gangs were at work on lifting the 16-in. pipes; one for disjointing, and the other for hoisting out, as we found we could work very rapidly in this way.

I tried to dislocate the pipes with a jack that I got made from an English pattern, but found it very slow work, and required room. I found that the burning out of lead joints, as described by Mr. Williams, was tedious and expensive work.

Yours faithfully,

John Ryan,

City Engineer.

St. John's, Newfoundland, Nov. 1, 1907.

The Corrugation of Rails.

Sir: In your issue of Oct. 24, in the report of the proceedings of the Atlantic City Convention of the A. S. & I. R. A., it appears that your account of my remarks on "Rail Corrugations" may leave a vague idea, and in some respects may cause an erroneous conclusion. Therefore it may be well to write this in order to establish the correct thought that should have been conveyed.

The idea advanced was, that corrugations were caused by the elongation of the upper surface of the metal of the rail under traffic or rolling action of the wheels. That such elongation does take place is an established fact. This can be seen in all old tracks, which appear in the streets in vertical and horizontal curves, the curves in both planes having the length of the rail. The horizontal curves have their maximum rise at the middle of the rail, curving inward so that the widest gage is at the joints. When an old track is taken up, the loose rails are distinctly and permanently curved. How could these curves be explained otherwise than by the elongation of the upper surface under the rolling action of the tread of the wheel and the friction of the flanges against the gage surface of the rail. The expansion of the exposed portion of the metal, due to the variation in temperature, could have very little, if any, influence upon this, for it works in both directions and therefore has a compensatory effect.

In order to understand this rolling action that causes the elongation, it can readily be assumed that the weight or pressure of the wheels produces an indentation in the surface of the rails. This indentation is moved along, causing the upper layer of the metal to flow in the direction of the traffic. When the movement of the wheels is slow it permits the metal to assume its original position on account of its elasticity. But when this movement is rapid, the stresses produced by this flow of the surface of the metal results either in curving of the rail (elongation of the surface) when the rail is on a loose foundation; or in case of a solid foundation which permits of no such distortion, it results in gradually pressing or rolling the surface metal until a maximum compression is reached when the metal is formed into a hump, over which the wheels roll and begin their action again; thus forming elevations and depressions at regular intervals—corrugations.

In assuming a cause in explanation of a phenomenon, such an assumption may only then be dignified as a theory, when, if not all, at least most of the known facts relative to such a phenomenon may be explained by this theory. And it appears to me that by careful analysis it will be found that by assuming the above theory as the cause for corrugations, all the varying, peculiar and seemingly contradictory manifestations of corrugations can be readily explained.

From the quotation it may further appear that there was an advocacy of a dirt foundation for track construction, and this is entirely contrary to what it was desired to assert. In order to explain under what conditions corrugations cannot occur it was assumed, and this is quite evident, that cars run on two parallel lines of rails loosely placed on the surface of the earth, and without being held down in any way, will never cause any corrugations. But in a question of track construction there are so many important and paramount considerations which must govern the decision, that the trouble of corrugations is but secondary. Economy in the permanency of roadbed and paving, to avoid the ruinous expense on the maintenance of track paving and rolling stock, the life of rail and joints, etc., is of so much vaster importance that the question of possible occurrence of corrugations (while the latter may be a contributing cause) can influence the decision but slightly. Aside from this, in paved streets loose tracks of such construction as mentioned above, where corrugations cannot occur, are out of the question, as they cannot be built. Therefore, there can be but the one conclusion that a firm and permanent foundation, with the rail held on it as firmly as it is possible to attain in practice, and an ideal one, such as concrete, upon which rails may be renewed without the disturbance of the foundation, is the only practical and economical construction that can be advocated for paved streets, and especially so on busily traveled streets. Corrugations will or may occur, but after one thorough, or possible two filings, they will never become a cause of annoyance again; for the upper and gage surface textures will be compressed into such hardness that the wheel will not produce further indentations.

Yours truly,

C. B. Voynow.

4187 Leidy Ave., Philadelphia, Pa., Oct. 30, 1907.

Stresses in the McCall Ferry Dam.

Sir: In Engineering News of Sept. 12 there is an article on the McCall Ferry dam, in which are shown the stress diagrams for the dam. As this method of calculating the pressures on the base of the dam has been the common method for some time, I would like to call the attention of your readers to the method used by the writer.

It will be noted in the case of the McCall Ferry dam stress diagrams that the diagram representing the pressure due to the gravity alone of the dam is a trapezoid, having the up-stream side drawn vertical and equal to 9,512 lbs., and the down-stream vertical side equal to 1,326 lbs.

The up-stream pressure is found from

$$p = \frac{2W}{L}\left(2 - \frac{3a}{L}\right)$$

The pressure of 1,326 lbs is found from

$$p' = \frac{2W}{L} - p.$$

The part of the computation to which the writer takes exception is in calculating the pressures due to the horizontal push of the water. This force as given for the McCall Ferry dam is 145,750 lbs. applied at a distance of 27.2 ft. above the base. Considering the dam as a cantilever having a thickness at the base of 1 ft. and a depth of 55 ft., we have for $M = 145{,}750 \times 27.2 = 3{,}964{,}400$ lbs.

$$S = \frac{M}{R}$$

Where R, the sectional modulus, equals, for a section 1 ft. thick,

$$\frac{D^2}{6} = \frac{55^2}{6} = 504:$$

then substituting

$$S = \frac{3{,}964{,}400}{504} = 7{,}864 \text{ lbs.}$$

which is the compressive pressure at the lower or down stream edge and the tensile stress at the upper or up stream edge. Therefore, it would seem that instead of having a trapezoid of water pressure of 2,045 at the up stream edge and 11,386 at the down stream edge, as given for the McCall Ferry dam, the water pressure creates a tensile stress at the up stream edge of the dam of 7,864: therefore, the diagram of total pressures gives 9,512 − 7,864 = 1,648 lbs. pressure at the up stream edge of the dam, and 7,864 + 1,326 = 9,190 lbs. at the down stream edge.

Yours truly,

R. C. Beardsley.

Cleveland, Ohio, Oct. 15, 1907.

[The seeming incongruity between the stresses noted in the diagram in our article and those derived by Mr. Beardsley is due to the different sections on which the two lines of pressure are computed. The method used by the engineers of the dam, viz.: assuming a surface normal to the line of thrust resulting from the water pressure and the weight of the dam and applying the regular formulas for eccentric vertical loads to that surface, has the authority of an extended usage, in addition to being as nearly rational as any of the other methods. It is one of the devices which has been adopted to care for the horizontal component of the inclined thrust which is entirely neglected in the methods of distributing the stresses by the formulas noted in the above letter. Owing to the addition of the weight of the triangle between the normal and horizontal base sections, which weight enters into the total vertical dead load of the dam, although its area lies below the section on which the stresses are computed, and also owing to the shortening of the length of the base, the stresses given by this theory are larger than by the horizontal base theory, but the difference is in the way of safety.

The extended computation given by Mr. Beardsley is not necessary to reach the results for the horizontal base theory. Applying the same formulas

$$p = \frac{2W}{L}\left(2 - \frac{3a}{L}\right)$$

$$p' = \frac{2W}{L} - p$$

to the dam with the water pressure acting, the pressures on the horizontal base will be

$$p = \frac{2 \times 297{,}970}{55}\left(2 - \frac{3 \times 21.1}{55}\right) = 9189$$

$$p' = \frac{2 \times 297{,}970}{55} - 9{,}189 = 1{,}647 \text{ lbs.}$$

In fact, the formulas noted above are directly derived from a combination of the formula for variable pressures under eccentric vertical load with the formula for opposite pressures due to flexural stresses from a horizontally applied water load.

It should also be noted that the method shown by Mr. Beardsley is subject to modification when there is a theoretical tension present in one side of a dam incapable of taking tension.—Ed.]

The "Permeable Dike" Method of Closing Levee Crevasses.

Sir: The very graphic description, in your issue of Oct. 24, 1907, by Mary W. Mount, of the successful closure of the "Live Oak" Crevasse on the Lower Mississippi River, should be of great value to levee engineers. The several attempts to close crevasses in levees, in years past, by building solid dikes of sheet-piling or other materials from either end, with the hope of joining them opposite the middle of the break, have proven their futility. The narrower the opening between the approaching dikes becomes, the deeper the gorge between is scoured, so that the water invariably attains an unmanageable depth before the two dikes can be brought to a closure.

For some years the writer has been anxious to see an attempt made to close a crevasse so located as to be accessible for steamboats and within reach of a ready source of the necessary supplies and equipment, by the general plan used at Live Oak. By the "general plan" is meant, first, building a permeable pile structure entirely around the breach, and afterwards filling it, uniformly along its entire length, with earth-filled sacks. The easy distance of the "Live Oak" Crevasse from New Orleans (27 miles), where all necessary materials could be procured promptly, and the fact that steamboats could reach the crevasse, made this an exceptional opportunity to attempt the closure by the method used, the success of which now speaks for itself.

The details of driving the piles, bracing the bents and handling the materials on tram-cars, portray a very practical handling of the situation with a view to saving labor and expediting the work.

If the Live Oak Crevasse, 230 ft. wide, could be closed by this method, it is only a question of a proportionately larger equipment and force to close a much wider crevasse, provided the probable duration of the high-water period be sufficiently great to justify the expense.

The author omitted to state the average depth of water through which the dike was built, which is one of the points of great interest, in considering the applicability of the method to other crevasses.

About three miles below Greenville, Miss., a crevasse was closed in 1903 by the Levee Board and U. S. Engineers, using a somewhat similar method. The presence of a large Government fleet at Greenville made it practicable to drive piles by steam and transport all materials on boats and barges, else it is believed that the depth of one narrow ravine crossed would have made the closure impracticable. The writer saw this crevasse after the water fell and believes that the depth was about 20 ft. in the ravine, which was narrow at the bottom and probably 250 ft. wide at the top. The entire length of the dike was much greater, but some of it consisted of a slight topping on existing old levees that had been formerly abandoned. A feature at this break was a willow mattress in the ravine.

In 1897, the writer, with valuable advice and cooperation by Major T. G. Dabney, Chief Engineer Yazoo-Mississippi Delta Levee District, closed the Flour Lake Crevasse, Tunica Co., Miss., by the same principle as was used at Live Oak, though the inaccessibility of the location necessitated the use of much cruder equipment. The crevasse was separated from the Mississippi River by two miles of heavy timber which steamboats could not penetrate, and was six miles from the nearest railroad station, the road from which was almost impassable. The distance to Memphis, the nearest material market, was about sixty miles by road and rail—much more by river. There were no telephones. All materials had to be transported in wagons, skiffs and hand-propelled flat-boats.

A pile dike was built round the "crater," on the river-side, very much in the same manner as at Live Oak, additional piles being driven between the bents as the latter were sufficiently advanced ahead, and a sack revetment of the bottom following closely the driving of the close piling, which was spaced about 1 ft. The piling was of 4 × 4-in. sawed timber, supplemented, when it could not be procured rapidly enough, by green poles which men in skiffs and flat-boats were constantly cutting in the woods and boating to the work. All piles were driven by hand with very heavy mauls, the strongest men available being paid extra to swing them, and a fresh supply of mauls being made almost daily to replace breakage.

A double runway was built on the dike—one side for out-going and the other for returning wheelbarrows, which conveyed the sacks to place after the pile dike had been completed and precautions taken against scour behind by the "overpour" which would be created.

The sacks were filled from the intact portions of the levee, on both sides of the break, and an "endless chain" of wheelbarrows was constantly moving them to the dike. The filling with sacks was begun in the deepest water, and as the crest of the impermeable sack filling was raised it was kept at a uniform level for the length of the dike, to guard against a concentration of scouring action at any point. The filling was continued until the crest was brought above the water surface and the flow entirely cut off. It is believed that this was the first successful application of the "permeable dike" method to crevasse closure and probably the inception of the method.

The width of the Flour Lake Crevasse was 2,000 ft. directly across the crater, the length of the dike being about 2,600 ft. The depth of water along the line of the dike, when it was built, varied generally from about 2 ft. to about 6 ft., with a depth of 13 ft. in a ravine crossed. The time occupied in this closure was about three weeks.

Yours very truly.

A. L. Dabney.

1511 Perkiomen Ave., Reading, Pa., Oct. 26, 1907.

The Deflection of a Beam of Non-Uniform Section.

Sir: In your issue of Sept. 26 the deflection of a given beam of variable moment of inertia is asked by one of your readers. I give here the solution:

The easiest way to solve this problem is by using Mohr's method of constructing the elastic curve, which is based on the identity of the formula thereof and that of the cord-curve, viz.:

$$H\frac{d^2y}{dx^2} = -g, \text{ and } EI\frac{d^2y}{dx^2} = -M$$

which formulas show that, provided $\frac{g}{H}$ be made equal to $\frac{M}{EI}$, the elastic curve can be constructed as a common cord-polygon. Exactly in this case of variable sections this method is superior to analytical solution, as integration causes some difficulty. In the above method this is easily overcome by putting

$$\frac{g}{H} = \frac{M}{E\phi I_a}$$

I_a being a certain moment of inertia, say of the beam's end, and ϕ the factor with which to multiply I_a to obtain the moment of inertia of the other sections.

I divided the beam into six parts of the following average moments of inertia: 77,777, 50,393, 35,000, 26,168, 17,674, and 13,251 in.^{4} and constructed the elastic curve for a 1,000-lb. load at the beam's end. Then according to Maxwell the deflection of the end due to the four 17,000-lb. loads = 17 × Σ deflections in the four points of application of those loads, giving a total of 0.634 in.

The own weight of the beam, about 9,000 lbs., is not taken into account. It can easily be calculated in the same way, using the same curve.

The method indicated may be found in any elementary treatise on graphic statics.

Very truly yours,

Abraham Streiff, C. E.

Exchange Bldg., Newark, N. J., Oct. 2, 1907.

Sir: The problem offered by "R. E. L." in Engineering News of the 26th of September may, assuming a knowledge of fundamental mechanics, be solved as follows:

1. Divide into small sections (say 1 or 2 ft. long), such lengths being preferably those containing no sudden changes in M (the bending moment in inch-pounds) or in I (the rectangular moment of inertia about the neutral axis in inches^4). Call these length l_1, l_2, l_3, etc., and express them in inches.

2. Compute M_1, M_2, M_3, etc., at the center of each section.

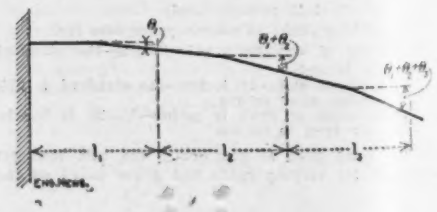
3. Compute I_1, I_2, I_3, etc., at the center of each section.

4. The angle θ, the deflection-angle between tangents to the curve of deflection at the ends of any section, is given by the formula

$$\tan\theta = \frac{M\,l}{E\,I}$$

where E is the modulus of elasticity in pounds per square inch. Compute θ_1, θ_2, θ_3, etc.

5. Assume the curve of deflection to be a broken line as shown in the following sketch:



6. The deflection at any point may now be computed by well-known trigonometrical formulas. In this case, and in most other cases, $\tan(\theta_1 + \theta_2 + \theta_3) = \tan\theta_1 + \tan\theta_2 + \tan\theta_3$. The above method presupposes stresses within the elastic limit and neglects deflection due to loose joints.

Excellent graphical methods exist by which this problem might be solved with much more speed and with sufficient accuracy, but I fear that a full explanation would use too much valuable space in your columns.

Horace R. Thayer.

712 South Linden Ave., Pittsburg, Pa., Oct. 1, 1907.

Sir: I note the query of one of your correspondents in your last issue, concerning the method of computing the deflection of a cantilever beam of varying section and moment of inertia, under concentrated loading. For this and like cases the analytical solution of the equation of the elastic curve becomes quite laborious, particularly when I is not a continuous function of x, e. g., cover plates of less length than the beam, etc. However, the problem lends itself very readily to a semi-graphic solution.

Consider the general equation of the elastic curve,

$$\frac{M}{E\,I} = \frac{d^2\,y}{dx^2}$$

where M and I are both functions of x.

$$\frac{M}{E\,I} = f(x)$$

$$f(x) = \frac{d^2\,y}{d\,x^2}$$

$$\therefore \int f(x)\,dx = \frac{dy}{dx} + C_1$$

Considering the case of the cantilever beam and taking the origin at the support, $dy/dx = 0$ when $x = 0$, hence

$$C_1 = \int_0^0 f(x)\,dx = 0$$

Then $$\iint f(x)\,dx\,.\,dx = y + C_2$$

Again $y = 0$ when $x = 0$, and $C_2 = 0$. therefore

$$\iint f(x)\,dx\,.\,dx = y$$

If now $f(x)$ be considered arbitrarily as load, the double integral is the moment about x of that part of the load between x and the origin.

Therefore, in order to determine the value of y, the deflection of the beam at any point, it is only necessary to compute the values of $f(x)$, i. e., M/EI at a sufficient number of sections of the beam, plat these values as a *load* curve, and the corresponding moment at any point, of the part of this load between the support and the point in question is numerically equal to the deflection of that point. It is to be borne in mind that the above-mentioned "moment" is not the "bending moment" of this load.

In the case of the simple beam, it will readily be found that the deflection at any point is numerically equal to the "bending moment" at that point, due to the loading M/EI.

Trusting that the foregoing may be of interest to some of your readers, while, no doubt, familiar to many, I remain,

Yours respectfully,

DeWitt D. Barlow.

Park Row Bldg., New York City, Sept. 30, 1907.

Sir: In your issue of Sept. 26 a correspondent presents the problem of determining the deflection at the end of a cantilever beam of variable depth and unsymmetrical section under concentrated loads.

The numerical operations required for the solution of this problem, involving as they do computations of the moment of inertia of a considerable number of sections, are necessarily laborious, but the method itself is relatively simple. The algebraic expression for the process is:

$$\Delta = \frac{1}{E} \sum_{x=0}^{x=l} \frac{M x\,dx}{I} \qquad \ldots\ldots\ldots\ldots(1)$$

where Δ = deflection required;
M = bending moment at a section distant x from the point whose deflection is sought;
I = moment of inertia at the same section;
E = coefficient of elasticity;
l = length of beam;
dx = any small fixed interval of length.

Fig. 1 represents the diagram resulting from plotting the values of $\frac{Mx}{I}$ for variant values of x. The area of the diagram is evidently the summation of $\frac{Mx}{I}\,dx$ for the entire length of the beam, which expressed in suitable units and divided by E gives the deflection.

The diagram may be plotted to any convenient scale

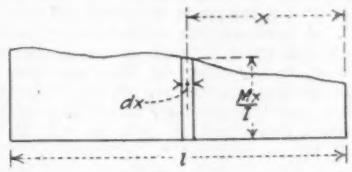


Fig. 1.

and the area may be found by the planimeter. If h is the number of inches of length per inch of horizontal distance and v the number of units of the quantity $\frac{Mx}{I}$ per inch of vertical scale, the area in square inches should be multiplied by $h\,v$, and the deflection in inches is:

$$\Delta = \frac{\text{area} \times h \times v}{E}.$$

Formula (1) may be derived by a method widely applicable to problems of deflection, somewhat less well known than the one leading to the equation of the elastic curve.

In the line diagram, Fig. 2, using the same notation, $m\,p$ represents the unbent beam before loading and $m\,n$

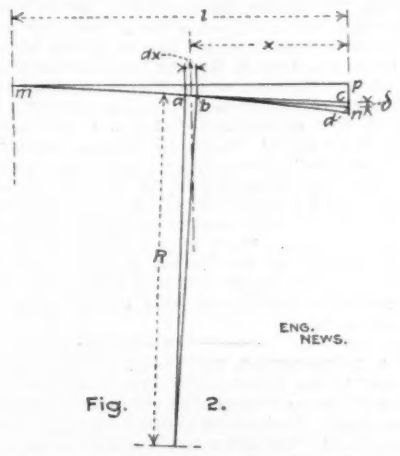


Fig. 2.

the beam under load. The limitations usually accepted in beam deflection problems are assumed.

A short length dx distant x from the end may be expressed:

$$dx = R\,d\alpha \qquad \ldots\ldots\ldots\ldots(2)$$

where R is the radius of curvature and $d\alpha$ is the angle about the center of curvature subtended by dx. If the beam is bent as far as the point a, the remaining portion $a\,c$ is tangent at a and the end falls some distance below p. If the beam is bent for a slightly greater distance dx, the tangent takes the position $b\,d$ and the distance $c\,d$ is the deflection, δ, at the end due to the curvature of the length dx at a distance x from the end. It is evident from inspection that the total deflection Δ is the sum of the values of δ for all the intervals dx along the length of the beam; therefore,

$$\Delta = \sum_{x=o}^{x=l} \delta \qquad \ldots\ldots\ldots\ldots(3)$$

From the diagram

$$\delta = x\,d\alpha$$

$$= x\frac{dx}{R} \qquad \ldots\ldots\ldots\ldots(4)$$

Inserting the value of the radius of curvature,

$$R = \frac{E\,I}{M}$$

gives $$\delta = \frac{M\,x\,dx}{E\,I} \qquad \ldots\ldots\ldots\ldots(5)$$

which substituted in (3) gives formula (1)

Lucien E. Picolet.

359 West 15th St., New York City, Oct. 14, 1907.

Sir: In the Sept. 26 issue of your journal you submitted a problem at the request of Mr. R. E. L. As understood the conditions given are shown by a sketch Fig. 1 herewith.

The peculiar points in this problem are the continually varying moment of inertia along the axis of the beam, due to the change in height of web-plate and to the addition of three plates *A*, *B* and *D*. This complicates the solution and also, at the same time, gives a greater interest to the problem from a practical point of view. It is unfortunate that many text books treating the subject of beam mechanics barely mention the cases where the moment of inertia varies along the neutral axis of the beam.

Suppose the distortion of a small length of the beam, dx, causes a certain deflection dy at the end. The angle representing the change in direction of this section of the neutral axis may be called δ. But δ is nearly the same as the angle between a plane perpendicular to the

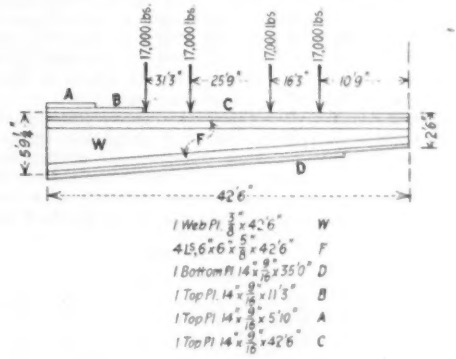


Fig. 1

axis at dx before bending takes place, and a plane perpendicular to the neutral axis at dx after bending. This angle is assumed to vary directly as the moment of the stress couple at C and inversely as the moment of inertia of the cross-section at this point. That is, $\delta = \frac{M}{EI}$

where E is the modulus of elasticity and I the moment of inertia.

The deflection at the end, dy, is equal to $x \times \delta$, where x is the distance from the section at dx to the point whose deflection is required; then

$$dy = \frac{Mx}{EI}$$

The total deflection, due to bending at all points along the axis of the beam is

$$D = \int \frac{Mx}{E\,I}\,dx$$

This formula is more carefully derived in many of the text-books in use at the present time. When M may be expressed as a function of x with E and I constant, the equation may be evaluated by an algebraic integration. When I varies and can be expressed as a function of x it may be placed under the integral sign and the process of evaluation will still be an algebraic one. When either E, I or M cannot be expressed as a direct function of x, and is not a constant, a graphical means of integration must be resorted to. This is the case in the above problem.

In the present case x is measured from the outer end of the beam toward the heel. In order to integrate the expression graphically it is necessary to compute both M and I for several sections. This was done for sections 7 ft. 1 in. apart; the values for M, I and $M \div I$ are given in the accompanying table. The units used were the foot and pound.

	—X—		—M—		I	—M/I—	
Section	ft.	in.	Live-load	Dead-load		Live-load	Dead-load
1	7	1	0	3,970	.5371	0	7,392
2	14	2	58,083	20,626	.9941	58,428	20,748
3	21	3	263,508	38,941	1.3619	193,480	28,593
4	28	4	548,260	71,035	1.7947	305,490	39,580
5	35	5	980,350	113,537	2.6627	368.180	42,645
6	42	6	1,462,000	167,889	3.7910	385,650	44,284

The values of $M \div I$ were plotted as ordinates on an abscissa scale of x to form curves similar to that shown

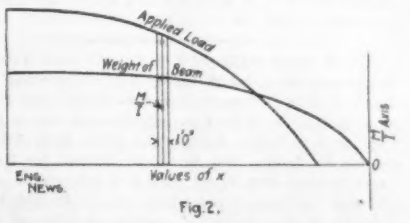


Fig. 2.

in Fig. 2. Considering that dx is equal to 1 ft. the integral part of the equation requires the sums of the products of the mean ordinates of every foot of length of diagram multiplied by their respective distances from the origin O. In the case of the curve for the live load the value of the integral is

$$\int \frac{Mx}{I}\,dx = 243{,}167{,}000,$$

Putting E equal to 30,000,000 lbs. per sq. in., and dividing by $144 \times E$, there results

$$D = .056287 \text{ ft.} = {}^{11}/_{16} \text{ in. very nearly.}$$

For the weight of the beam alone we have the value of the integral

$$\frac{I}{E}\int \frac{Mx}{I}\,dx = \frac{31{,}815{,}525}{144 \times 30{,}000{,}000} \text{ ft.} = 3{,}82 \text{ in.}$$

This gives a total of ${}^{29}/_{32}$ in. for the deflection of the beam. It is obvious that the weight of the beam might have been put with the live load and the total integration made from one curve. But in order to obtain the relative effect produced by the weight of the beam, the two curves were kept separate.

The load applied uniformly over the girder which will produce an equivalent moment at the heel of the beam is 77,354 lbs. Taking the moments of inertia computed at the end sections of the beam and considering their average as the moment of inertia of a beam of constant cross-section, we may use a standard formula and compute the deflection:

$$D = \frac{Wl^3}{8EI}$$

where W is the total uniformly-distributed load on the girder,
l is the length of the girder,
I the average moment of inertia, equal to half the sum of the values for the two end sections.

This gives $D = .07940$ ft. $= {}^{31}/_{32}$-in.

Assuming the moment of inertia of section 5 shown in table as the one that would be expected to have the most influence, and using the same formula, there results:

$$D = .06453 \text{ ft.} = {}^{25}/_{32}\text{-in.}$$

This is practically the same as was obtained by the more accurate method.

G. L. Bilderbeck.

East Berlin, Conn., Oct. 7, 1907.

[Another correspondent writes that he has found very useful, in calculating deflections of girders with variable moment of inertia, a paper by Mr. C. W. Hudson, "Deflections of Beams with Variable Moments of Inertia," Trans. Am. Soc. C. E., Vol. 51, p. 1.—Ed.]

Notes and Queries.

In our issue of Oct. 17 we referred to the Geological Survey and the Ordnance Department of the army as the only two organizations of the Federal Government which undertake original investigations of the strength of materials. A correspondent calls our attention to the fact that the Forest Service is also engaged in extensive investigations of the strength of timber, and it is possible that some work in testing materials is done in the Bureau of Standards.

THE FALL OF A CAGE in a coal mine at Collard, near Liege, Belgium, is reported, in a despatch dated Nov. 4, to have killed or fatally injured the 13 men upon it. The cage fell 360 ft.

THREE SERIOUS EXPLOSIONS were recently reported within three days of each other. At Steubenville, Ohio, on Nov. 6, the boiler of a narrow-gage locomotive exploded at the La Belle Iron Works, killing five men and fatally injuring three. Part of the open-hearth steel plant was wrecked.

A press despatch from Kiel, Germany, dated Nov. 6, states that the boilers in the German school-ship "Blücher" exploded, killing 10 men and injuring 22.

A powder train on the narrow-gage railroad of the Pilares Mine, near Douglas, Ariz., caught fire on Nov. 7 and two cars of dynamite exploded. The engineer, who, it is said, stuck to his post and ran the burning train through the town at top speed, was killed, as were ten section hands in a section-house beside the train, which was demolished.

THE WORST RAILWAY ACCIDENT OF THE WEEK is reported from Little Rock, Ark., in a press despatch dated Nov. 4. Five persons were killed and a score or more injured in a head-on collision between a passenger train and a freight train eight miles from Little Rock on the St. Louis, Iron Mountain & Southern Ry.

One person was killed and five injured in a similar collision between a passenger and a freight train, on Nov. 9, on the Boston & Albany division of the New York Central R. R., near West Brookfield, Mass. The express was an hour late and was making up time.

A fast east-bound passenger train on the Delaware, Lackawanna & Western R. R. was wrecked on Nov. 8, near Fargo, N. Y., by a collision with a freight train. The engineer of the passenger train was killed, but no passengers were hurt.

A bad collision occurred in the Fort Wayne (Ind.) yards of the Wabash R. R. on Nov. 9 between a passenger train and a freight train. Thirty-five passengers were injured. A misunderstanding of the time of the passenger train by the yard master at Fort Wayne is the reported cause.

In a collision between electric cars near Woonsocket, R. I., on Nov. 9, one person was killed and seven severely injured. A passenger car collided with a railway construction car, which, through failure of the brakes or because of slippery rails, slid backward down a grade, striking the passenger car near the foot of the hill.

A high-speed interurban car on the Muncie division of the Indiana Union Traction Co.'s line left the rails, on Nov. 7, in the outskirts of Indianapolis. Thirty-five passengers were injured, one fatally. The cause of the accident is said to have been the failure of the air-brakes to work while the car was nearing a curve. The car left the rails and landed on its side.

THE AMERICAN MUSEUM OF SAFETY DEVICES and Industrial Hygiene is now permanently located in the new concrete building at 231-241 West 39th St., New York City, where an exhibit of appliances and methods for protecting the lives and limbs of workmen is being installed. The work of the Museum is being carried on with the assistance of an Advisory Council made up of the editors of the principal engineering journals published in New York City. Applications for space for exhibits should be addressed to the Director of the Museum, Dr. W. H. Tolman. At the recent International Book, Paper and Publicity Exposition held in Paris last summer, the Grand Prix was awarded to the Museum, and a Diploma of Honor was given to Messrs. Charles Kirchhoff, M. Am. Inst M. E., and T. C. Martin, Assoc. Am. Inst. E. E., who are respectively Chairman and Vice-Chairman of the Museum Advisory Council.

A dinner was given at the Engineers' Club in New York City, on the evening of Nov. 9, by Mr. Kirchhoff in honor of Col. Carroll D. Wright, formerly United States Commissioner of Labor. During the dinner Colonel Wright was decorated with the Cross of the Legion of Honor by a representative of the French Government, in recognition of his international reputation as a statistician and economist. Those present at the dinner included the members of the Advisory Council of the Museum. Congratulatory letters to Colonel Wright were read from President Roosevelt and other officers of the Federal Government.

A PHENOMENAL CONCRETE ARCH SPAN is proposed by the Department of Bridges of New York City for the Henry Hudson Memorial bridge, bridging Spuyten Duyvil Creek at the northern extremity of Manhattan Island. The bridge is a highway viaduct a third of a mile long, crossing the creek by a single arch of 710 ft. clear span and about 183 ft. vertical clearance at the crown above the water. The arch foots on rock foundations near the water's edge on either side. It is designed with open spandrels (cross-walls and relieving arches). The viaduct either side of the main span is carried by a series of 100-ft. semicircular arch spans. Fuller details will be available shortly. The general elevations of the bridge were submitted on Nov. 12 to the Art Commission of the City of New York, for esthetic approval.

AN EXHIBITION OF CEMENT and cement products is to be held at the Coliseum, Chicago, Dec. 17 to 21, 1907. It will include machinery used in connection with cement and concrete work, engineers' and architects' plans of structures, technical literature, and the work of testing beams, etc., of reinforced concrete. Several engineering and technical schools are expected to contribute to this last class of exhibits. This is the first annual "cement show," and is under the management of the Cement Products Exhibition Co., L. L. Fest, General Manager, New Southern Hotel, Chicago. The organization committee is composed of B. F. Affleck (Universal Portland Cement Co.), Wm. Dickinson (Marquette Cement Mfg. Co.), and J. V. C. McDaniel (Chicago Portland Cement Co.).

THE WORK ON THE GATUN DAM AND LOCKS on the Panama Canal has been progressing in a satisfactory manner. The rumor as to the unreliability of the foundations at this location is contradicted by the latest report from the Isthmus, reproduced below from the "Canal Record":

The new borings which have been made over the entire area of the lock site at Gatun show that the locks will rest for their entire length on rock; all doubt on this point has been removed. Work on the designs of the locks, gates and sluiceways is advancing steadily, and from the project studies certain points have been decided. The gates are to be in duplicate and of the miter type, and the rolling gate, similar to that now in use on the Ohio River will be substituted for the duplicate set at the lower end of each summit level lock. In addition, there will be provided an auxiliary pair of gates at the lower end of each flight, for use as cofferdams in case it may be necessary to pump out the locks, and it has been determined tentatively to adopt a swing bridge type of dam for emergency use. The method of filling and emptying the locks has been finally decided upon. The cross-section of the dam has been slightly changed and the upstream slope has been made more gradual than originally proposed. New borings have been made in the vicinity of the Pedro Miguel locks and dam, and excavation for the lock site is proceeding steadily.

NEW YORK CITY'S HIGH BUILDINGS have been counted and classified as to number of stories by Parker & Lee, of 20 Broad St., of that city. The results of this count show that since 1890 the number of buildings over 12 stories erected as "new buildings" (i. e., not counting alterations and rebuilding), number 104, according to the record of permits issued by the Bureau of Buildings of the borough of Manhattan. In addition 434 buildings of 10 to 12 stories were erected, making the total 538 buildings having 10 or more stories above ground. The detailed count is as follows:

Stories above ground.	Number of Buildings.
48	1
41	1
26	2
25	3
23	2
22	4
20	9
19	2
18	9
17	2
16	10
15	19
14	18
13	13
12	109
11	101
10	104

The two first in this list are the tower of the Metropolitan Life Insurance Co. building at 24th St. and Madison Ave. (48 stories) and the tower of the Singer Bldg., at Broadway and Liberty St. (41 stories). These, and a number of others in the list, are not yet completed. The record is not complete for New York City, moreover, as there is a number of buildings in the borough of Brooklyn exceeding 9 stories in height. In the above list, the sudden drop in number of buildings as 12 stories is chargeable to the extra restrictions imposed by the Building Code of the city of New York on buildings exceeding in height 150 ft. above the curb line.

SEWAGE AND SEWAGE EFFLUENT ANALYSES showing the results obtained with septic tanks, percolating filters and final shallow filters of fine-grained material, at the sewage works of Salisbury, England, have been sent to us by Mr. Alfred C. Bothams, Assoc. M. Inst. C. E., City Engineer and Surveyor. The samples were collected on Oct. 2 and 3, 1907, and the results, expressed in parts per 100,000, were as follows:

	Sewage.*	Tank Effluent.	Bacteria Beds.	Final Filters.
Saline ammonia	4.60	4.00	1.80	.80
Albuminoid ammonia	1.24	.54	.14	.07
Total nitrogen (Kjeldahl)	5.80	4.40	2.00	2.0
Nitrogen as nitrate and nitrite	none	none	1.11	1.24
Oxygen absorbed—				
In 4 hrs. at 80° F.	7.10	2.70	.80	.40
After incubating a week	..	..	.252	.160
Quick incubator test	putrescible	putrescible	impurescible	impurescible
Chlorine as chloride	7.60	7.60	7.20	6.0
Suspended solids—				
Organic	152	11	5	none
Mineral	19	2	none	none
Total	171	13	5	none

*The sewage was sampled as it entered the septic tanks after being lifted.

GAS WORKS WASTES give no little trouble to those in charge of the sewerage systems of many of our cities, and they are also a frequent cause of very serious stream pollution. A somewhat lengthy paper, entitled "Wastes from Lowell Gas Light Company's Yard," by Arthur T. Safford, is published in the "Journal of the Association of Engineering Societies" for September, 1907. The troubles encountered at Lowell and the methods of alleviating them were mostly quite local in character. They involved a thorough drainage system for a large yard that was saturated with gas-works wastes, and also the installation of filters treating some of the wastes. The main conclusions of the paper are of sufficient general interest to warrant quotation, as follows:

The ordinary wastes of a coal and water gas plant can be taken care of within the works by separating and burning the heavier matters and treating chemically or filtering through coke the lighter liquids, and the effluent will not cause trouble in the public sewers; but this effluent should be treated specially if the sewage is disposed of on land.

Storage tanks for several days' waste, which are perfectly tight, should be provided against breakdowns in the collection of waste products, and should be divided into compartments, with overflows, in order to separate the wastes whenever necessary.

If the ground within the yard is porous and there are old wastes of an objectionable nature which have accumulated, these should be filtered through coke before being discharged, and for the best results a separate system of storm water drains should be provided to include roof water as well as surface water; if it is necessary to keep the ground entirely clean the yard may be concreted.

LOCOMOTIVES OF THE MALLET COMPLEX TYPE are in use on four railways in this country and aggregate about 50 in number. The latest, for the Erie Ry., were described in our issue of Oct. 3. The Baldwin

DIMENSIONS OF MALLET DUPLEX LOCOMOTIVES.

	Northern Pacific Ry.	Great Northern Ry.	Great Northern Ry.
Driving wheels	4 ft. 7 ins.	4 ft. 7 ins.	4 ft. 7 ins.
Truck wheels	2 ft. 6 ins.	2 ft. 6 ins.	2 ft. 6 ins.
Trailer wheels	3 ft. 0 ins.	3 ft. 0 ins.	3 ft. 0 ins.
Wheelbase, driving (each group)	10 ft. 0 ins.	10 ft. 0 ins.	9 ft. 10 ins.
Driving	30 ft. 0 ins.	30 ft. 0 ins.	.....
Total engine	44 ft. 10 ins.	44 ft. 10 ins.	43 ft. 7 ins.
Engine and tender	72 ft. 9½ ins.	73 ft. 2½ ins.	72 ft. 0¼ in.
Weight on driving wheels	313,550 lbs.	316,000 lbs.	283,350 lbs.
On trucks	38,050 lbs.	39,000 lbs.	39,300 lbs.
Total engine	351,600 lbs.	355,000 lbs.	302,650 lbs.
Engine and tender	500,000 lbs.	503,000 lbs.	450,000 lbs.
Cylinders, h. p.	21½ × 32 ins.	21½ × 32 ins.	20 × 30 ins.
Cylinders, l. p.	33 × 32 ins.	33 × 32 ins.	31 × 30 ins.
Valves	Slide	Slide	Slide
Valve gear	Walschaert	Walschaert	Walschaert
Boiler, diameter	7 ft.	7 ft.	6 ft.
Steam pressure	200 lbs.	200 lbs.	210 lbs.
Firebox (Belpaire)	117 × 96 ins.	117 × 96 ins.	116¼ × 66¼ ins.
Depth, front	79½ ins.	79½ ins.	72 ins.
Depth, back	76½ ins.	76½ ins.	64¼ ins.
Water spaces	5 and 6 ins.	5 and 6 ins.	5 ins.
Tubes, No.	437	441	301
Diameter	2¼ ins.	2¼ ins.	2¼ ins.
Length	21 ft.	21 ft.	21 ft.
Heating surface: tubes	5,583 sq. ft.	5,433 sq. ft.	3,708 sq. ft.
Firebox	225 sq. ft.	225 sq. ft.	198 sq. ft.
Total	5,608 sq. ft.	5,658 sq. ft.	3,906 sq. ft.
Grate area	78 sq. ft.	78 sq. ft.	53½ sq. ft.
Water on tender	8,000 gals.	8,000 gals.	8,000 gals.
Coal on tender	13 tons	13 tons	13 tons

Locomotive Works have supplied several to the Great Northern Ry. (Engineering News, Sept. 27, 1906) and have recently delivered 16 to the Northern Pacific Ry. All of these are of the 2-6-6-2 class, and are for regular freight service. The principal dimensions are as shown in the accompanying table.

THE CUNARD LINER "LUSITANIA" has again lowered the transatlantic record, by arriving at Sandy Hook at 1:40 a. m. on Nov. 8, after 4 days, 18 hours, 40 min. from Daunt's Rock. This was 1 hr., 12 min. better than her previous record—also a world's record. The average hourly record for the 2,781 miles was thus approximately 24.25 knots per hr. The vessel's daily average steaming was more than 600 knots, and her best day's steaming was 618 knots. Exceptionally heavy weather prevailed throughout the voyage.

The "Mauretania," her slightly larger sister ship, completed a 1,200-mile trial run (official) on Nov. 5, over a measured 300-mile course. Her average speed for the 1,200 miles was 26.03 knots per hr.; and a despatch to the New York "Times" states that its London correspondent had been officially advised by the Cunard Co. that the vessel had covered 300 miles—from Liverpool to Lands End and back—at an average speed of 27.36 knots per hr. The "Mauretania" leaves Liverpool for her first voyage on Nov. 16, and should she maintain her speed of 26.03 knots her time for the transatlantic voyage will be less than 4 days, 11 hrs.

PERSONALS.

Mr. S. W. Higley, Roadmaster at Phoenix, Ariz., for the Sante Fe, Prescott & Phoenix Ry., has resigned.

Mr. B. W. Hicks has been appointed Chief Engineer of the Wisconsin & Michigan Ry., with office at Peshtigo, Wis.

Mr. Chas. K. Lord has been elected President of the Tonopah & Goldfield R. R. Co., succeeding Mr. John W. Brock.

Mr. Eugen F. Kriegsman, of Portland, Ore., has accepted a position with the People's Water Co., of Berkeley, Cal.

Mr. J. F. Leonard has been appointed General Inspector of Signals on the Chesapeake & Ohio R. R., with offices at Richmond, Va.

Mr. John W. Young, General European Manager of the Allis-Chalmers Co., has resigned and will return to America about Dec. 1.

Mr. H. C. Page, General Manager of the Springfield (Mass.) Street Ry. Co., has been elected Vice-President and General Manager.

Mr. E. G. Herndon, of the Dodge Coal Storage Co. of Philadelphia, has been appointed Resident Engineer for the company at Chicago.

Mr. Byron T. Burt, Manager of the Chattanooga Light & Power Co., Chattanooga, Tenn., has resigned. Mr. W. E. Bolleau will succeed him.

Mr. R. E. Boswell, Superintendent of the Alabama Great Southern Ry., has resigned to accept a position with the Seaboard Air-Line Ry.

Mr. William D. Kennedy has been appointed Superintendent of Motive Power of the Central Vermont Ry. to succeed Mr. A. Buchanan, resigned.

Mr. W. W. Palmer, of Rossburg, B. C., has been appointed Roadmaster for the Grand Forks division of the Great Northern Ry. in British Columbia.

Mr. Geo. W. Boschke, Chief Engineer of the Oregon R. R. & Navigation Co., has had his jurisdiction extended over the Corvallis & Eastern R. R.

Mr. W. A. Freese, Superintendent of Telegraph of the Chicago & Alton Ry., has had his jurisdiction extended over the Toledo, St. Louis & Western R. R.

Mr. John Wood, Marine Superintendent of the Risdon Iron Works, of San Francisco, has resigned to take a similar position with the Moore & Scott Iron Works.

Mr. A. E. Carey, Superintendent of the Edmonton division of the Canadian Northern R. R., has resigned. He has been succeed by Mr. W. A. Brown, of Winnipeg.

Mr. William C. Shaw, Jr., has been appointed Chief Engineer of the Georgia Southern & Florida Ry. Co., with headquarters at Macon, Ga. He succeeds Mr. Geo. B. Herington, resigned.

Mr. J. P. Hallihan, Chief Engineer of the Rio Grande, Sierra Madre & Pacific R. R. and of the Sierra Madre & Pacific R. R., has resigned to accept a position with the South American Coast Construction Co.

Mr. W. T. Guy has been appointed Chief Engineer of the St. Louis, Hillsboro & Southern Ry., and Mr. Henry Rohner has been appointed Consulting Engineer. The company contemplates building 260 miles of road.

Mr. S. R. Poulin, District Engineer at North Bay, Ont., for the Transcontinental Railroad Commission, has been appointed Resident Engineer of the Abitibi section with headquarters at Winnipeg, succeeding Major Hodgins, resigned.

Mr. Wm. J. Wilgus, M. Am. Soc. C. E., formerly a vice-president of the New York Central (resigning on Oct. 1), has been retained as Consulting Engineer by the Detroit River Tunnel Co. He was actively identified with the preparation of the plans for the Detroit River tunnel.

Mr. J. Markey has been appointed Master Mechanic of the Middle division of the Grand Trunk Pacific Ry., with headquarters at Toronto, succeeding Mr. W. Kennedy, resigned. Mr. W. Bell has been appointed Master Mechanic of the Ottawa division, with headquarters at Ottawa, in place of Mr. J. R. Donnelley, transferred.

Mr. C. K. Koppes has resigned as Assistant Engineer of the Chicago, Milwaukee & St. Paul Ry. Mr. Alexander Brown has been appointed to succeed Mr. L. R. Clausen as Signal Engineer, Mr. Clausen having been promoted to the position of Superintendent of the Prairie du Chien and Mineral Point divisions, with offices at Milwaukee.

Col. Walter B. Hotchkin, of the 22d Regiment of Engineers, N. G., N. Y., was tendered a dinner on Nov. 6 in honor of the 25th anniversary of his enlistment in the National Guard service. The dinner, which was held at the Hotel Marie Antoinette, followed the conferring upon him of the brevet title of Brigadier-General.

Mr. W. R. Scott, General Superintendent of the Operating Department of the Southern Pacific Co., Coast Division, has been promoted to the position of Assistant General Manager. Mr. T. A. Lawson, whose resignation as Assistant General Superintendent of the Chicago & Northwestern Ry. we noted here last week, will succeed him.

Mr. C. T. O'Neal has been appointed Superintendent of what will be known hereafter as the New York Division of the Lehigh Valley R. R., which Mr. M. B. Cutter, General Manager, announces will include that portion of the road east of and including Parkview Station, N. J., and the National Docks and Jersey City and Newark Terminals.

Mr. E. F. Robinson, of Rochester, N. Y., former Assistant Engineer of Track, has been appointed Chief Engineer of the Buffalo, Rochester & Pittsburg Ry. Co., succeeding Mr. J. M. Floesch, who resigned several weeks ago to accept a position with a large construction firm in Canada, engaged in construction work on the Grand Trunk Pacific Ry.

Mr. I. W. McConnell, engineer in charge of the construction of the Gunnison Tunnel in Colorado, while in Washington recently on reclamation service business, received the appointment as Supervising Engineer in charge of the reclamation work in Colorado, Kansas, the North Platte project, the Nebraska-Wyoming project, and the Bell Fourche project in South Dakota.

Mr. H. B. Ayres, formerly General Manager of the Locomotive & Machine Co., of Montreal, has resigned to accept the general managership of the H. K. Porter Locomotive Co., of Pittsburg, and will move his headquarters at once to that city. Mr. A. W. Wheatley, General Inspector of the American Locomotive Co., at Schenectady, N. Y., succeeds Mr. Ayres at Montreal.

Mr. H. W. Connell, of the firm of Connell, Sykes & Connell, Engineers, 90 West Street, New York City, has recently been retained as Consulting Engineer to the Hannawa Falls Power Co., of Potsdam, N. Y. Under his supervision the company is making large additions to its equipment and extending its transmission lines. Mr. Connell will spend a large part of the coming winter at Potsdam, giving this work his personal attention.

Mr. Edward S. Moore, a clerk in the office of President A. J. Davidson, of the St. Louis & San Francisco R. R., was promoted on Nov. 8 to the assistant superintendency of the San Francisco terminals of the Chicago, Rock Island & Pacific Ry., the St. Louis & San Francisco R. R. and Chicago & Eastern Illinois R. R. Mr. Moore is the son of W. H. Moore, of New York City, who is prominently identified with the controlling interests of these lines; he entered the offices to learn the railroad business.

Mr. H. L. Hibbard, Electrical Expert to the Bureau of Construction and Repair, U. S. Navy Department, has resigned that position to enter the employ of The Cutler-Hammer Mfg. Co., of Milwaukee, makers of electric controlling devices. Mr. Hibbard's experience in navy-yard and shipboard work extends over a period of eight years, four of which were spent in the office of the Superintending Naval Constructor at Newport News, in supervising installations of electrical apparatus on ships built and equipped at that yard.

Mr. J. H. Quinton, Consulting Engineer in the U. S. Reclamation Service in charge of Nevada, Utah, and Colorado, with headquarters at Provo, Utah, has resigned the supervisory work of his district on account of ill health, but will continue in the service on a consulting basis. Mr. Quinton was born in Ireland and educated at Queens College, Belfast, and Queen's College, Galway. He came to this country in the early '70's and has been prominently identified with important railroad and canal construction and general engineering work throughout the West since that time, having built more than seventy tunnels, some of large size. It is probable that the several states which have been under his supervision will be added to adjoining districts.

Obituary.

C. W. Sanders, Chief Engineer of the Copper Range R. R., died at Houghton, Mich., on Nov. 4, aged 51 years.

Alexander Maitland, President of Edward Smith & Co., makers of metal coatings, of New York and Chicago, died on Oct. 25 at Princeton, N. J.

Capt. Richard Skewes, an old-time and well-known mining man of Pachuca, Mex., died at Chacewater, England, on Oct. 13, at the age of 75.

Thomas F. Bartlett, Vice-President and General Manager of the Metropolitan Steamship Co., of New York City, died on Nov. 6. He was 49 years old.

Frank S. Strite, Manager of the Pittsburg Car Service Association, and well known in railroad circles throughout the southwest, died on Nov. 11 at Pittsburg.

James F. Jones, for 20 years Chief Consulting Engineer of the Reading R. R. system, under the late President McLeod, died in Philadelphia on Nov. 7 at the age of 69.

Jesse Newton Seale, Manager of the Northeast lines of the Southern Railway, died at the George Washington University Hospital at Washington, D. C., on Nov. 11. He was stricken with paralysis at Salisbury, N. C., on Nov. 9. Mr. Seale was born in Mississippi in 1862.

Richard D. Hurley, Manager of the Pittsburg office of the Independent Pneumatic Tool Co., died at Chicago on Nov. 5, after a brief illness with heart trouble, at the age of 39. Mr. Hurley had been connected with the pneumatic tool business for ten years. He was unmarried, and was a brother of Mr. John D. Hurley, Vice-President and General Manager of the company.

Dr. George S. Beane, head of the Department of Physics of the College of Liberal Arts at the University of Southern California, Los Angeles, and Professor of Physics, Chemistry and Metallurgy there, dropped dead on Oct. 31 in a Los Angeles street car. He was also head of the Department of Electrical Engineering at the Los Angeles Y. M. C. A. Dr. Beane was a graduate of Toronto University and a post-graduate of Johns Hopkins University. He was a Canadian by birth, and was 47 years of age.

Charles E. Perkins, formerly President of the Chicago, Burlington & Quincy R. R. Co., and one of the leading railway men of this country, died at Westwood, a suburb of Boston, on Nov. 8. He was born in Cincinnati in 1840. In 1859 he went to Burlington, Iowa, and became a clerk with the Burlington & Missouri River R. R. In five years he had become Superintendent. He was elected President of the Chicago, Burlington & Quincy R. R. Co. in 1881, after a service with the road of seven years. In 1901 he resigned. Mr. Perkins was also a director in the American Bell Telephone Co.

Frank Hasbrouck Earle, senior member of the firm of Earle & Harrison, Civil Engineers, of Jersey City, N. J., died on Nov. 7 at his home in Newark. He was born in 1852 in New York City, and moved to Jersey City when a young man. Since 1870 he had practiced civil engineering and surveying throughout Hudson County, N. J., and for 21 years had been in partnership with Mr. Edlow W. Harrison, M. Am. Soc. C. E. Mr. Earle was considered an authority in consulting work in the financial and appraising phases of engineering. He had had considerable experience in railway work, and was expert in matters pertaining to trunk-line car service. He was President of the Raritan River R. R. Co., and a Director of the Hudson County National Bank and of the New Jersey Title Guarantee & Trust Co., both of Jersey City. A wife and four sons survive him, one of whom is Mr. Frank Hasbrouck Earle, Jr., Jun. Am. Soc. C. E.

ENGINEERING SOCIETIES.

COMING MEETINGS.

PUBLIC HEALTH-DEFENSE LEAGUE.
Nov. 18. Annual meeting at New York City. President, Austen G. Fox, 45 Wall St., New York City.

AMERICAN INSTITUTE OF ARCHITECTS.
Nov. 18-20. Annual convention at Chicago. Secy., Glenn Brown, The Octagon, Washington, D. C.

ATLANTIC DEEP WATERWAYS CONFERENCE.
Nov. 19-20. Conference at Philadelphia. Chairman, J. Hampton Moore, Bellevue-Stratford Hotel, Philadelphia.

AMERICAN CIVIC ASSOCIATION. }
NATIONAL MUNICIPAL LEAGUE. }
Nov. 19-21. Joint convention at Providence, R. I. Secy., Clinton R. Woodruff, North American Building, Philadelphia.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
Nov. 21-22. Fifteenth general meeting at New York City. Secy., W. J. Baxter, 29 West 39th St., New York City.

NATIONAL DRAINAGE ASSOCIATION.
Nov. 25-27. Annual convention at Baltimore. Chairman Ex. Com., Col. A. G. Bernard, 1420 New York Ave., Washington, D. C.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 3-6. Fifty-fourth annual meeting at New York City. Secy., Calvin W. Rice, 29 West 39th St., New York City.

SOCIETY FOR THE PROMOTION OF INDUSTRIAL EDUCATION.
Dec. 5-7. Convention at Chicago. Secy., C. R. Richards, Columbia University, New York City.

ASSOCIATION OF TRANSPORTATION AND CAR-ACCOUNTING OFFICERS.
Dec. 10. Annual winter meeting at Chicago. Secy., G. P. Conard, 24 Park Place, New York City.

NATIONAL ASSOCIATION OF CEMENT USERS.
Jan. 20-25. Fourth annual convention at Buffalo. Secy., W. W. Curtis, 585 Caxton Bldg., Chicago. Convention Manager, Dal H. Lewis, 760 Main St., Buffalo.

CORNELL SOCIETY OF CIVIL ENGINEERS OF NEW YORK.—This society will hold a smoker on Nov. 22, at the Engineering Societies Building. Mr. A. H. Higley, of 504 West 143d St., is Corresponding -Secretary.

ATLANTIC DEEP WATERWAYS CONFERENCE.—The object of this congress, to be held Nov. 19 and 20 at Philadelphia, is to discuss the establishment and maintenance of continuous inland waterways along the Atlantic Coast, from Cape Cod to North Carolina.

The committee on arrangements is preparing for a series of papers covering in sections the entire route; a list of these papers, however, has not been published.

TEXAS ASSOCIATION OF CIVIL ENGINEERS.—The fourth annual meeting was held at Galveston on Oct. 25 and 26. After the business of the association had been transacted, the following papers were presented: "The Street-Paving Situation in Texas," by Chas. S. Wadsworth, of Dallas; and "Location of Irrigation Pumping Plants," by H. L. Hutson, of Houston.

Officers elected for the coming year were: President, E. L. Dalton, City Engineer of Dallas; Vice-President, A. T. Dickey, City Engineer of Galveston; Secretary (reëlected), E. C. H. Bantel, Assoc. M. Am. Soc. C. E., Adjunct Professor of Civil Engineering, University of Texas, Austin.

ASSOCIATION OF TRANSPORTATION AND CAR ACCOUNTING OFFICERS.—The winter meeting will be held at the Auditorium Hotel, Chicago, on Dec. 10 and 11. The following committee reports will be considered: Car Service and Per Diem; Office Methods and Accounting; Handling Railroad Business Mail; Conducting Freight Transportation; and Conducting Passenger Transportation.

PUBLIC HEALTH DEFENSE LEAGUE.—The first annual meeting of this league, organized in November, 1906, and incorporated in April, 1907, will be held at the Academy of Medicine, 17 West 43d St., New York City, on Nov. 18 at 2 P. M. The Committee of One Hundred on National Health was formed in June, 1906, under the auspices of the American Association for the Advancement of Science. Neither body was aware of the existence of the other, at an earlier stage of their existence. At this meeting the plan is to consolidate the two as the American Health League, under the auspices of the Committee of One Hundred.

WESTERN SOCIETY OF ENGINEERS.—At the meeting held at the society's rooms at Chicago on Nov. 6, Mr. A. S. Zinn gave an interesting talk on "The Construction of the Panama Canal." It was accompanied by stereopticon views. At a meeting of the Electrical Section of the society on Nov. 8, Mr. H. V. Allen gave a lecture on "The Color Values of Artificial Lights," illustrated by a number of experiments and optical demonstrations. A special meeting is to be held on Nov. 16, at which Mr. J. W. Alvord will lecture on "Engineering in Mexico," illustrating this with stereopticon views from a number of photographs taken by him during the visit of the American Society of Civil Engineers last summer.

AMERICAN CHEMICAL SOCIETY.—At the meeting of the New York Section, Nov. 8, at the Chemists' Club, 108 West 55th St., a paper by Prof. W. L. Dudley, Vanderbilt University, Nashville, Tenn., was presented, on "The Effect of Coal Gas on the Corrosion of Wrought-Iron Pipe Buried in the Earth."

This paper described two series of experiments on pieces of wrought-iron pipe of 1 in. inside diameter and 10½ ins. long. These samples were all carefully cleaned in a warm solution of ammonium citrate, which possesses the property of removing all iron oxide without attacking the metal itself, and after drying were weighed. In the course of the first series of experiments several specimens of pipe were placed in wooden boxes which were painted on the inside with certain compounds so as to prevent any solutions held in the wood from acting on the iron. The pipes were buried in earth, from certain definite localities, tamped in the boxes. To each box there was added 50 c. c. of water daily, except Sundays, for 12 months. In the course of the second series of experiments similar pieces of wrought-iron pipe were buried in boxes of earth under the same conditions except that in this series each box also contained a perforated pipe through which 0.5 cu. ft. of coal gas daily was caused to pass into the earth about the experimental pipe. Each sample of earth was wetted precisely as in the other series. At the end of 12 months the iron pipe samples of both series were removed, carefully cleaned with a warm solution of ammonium citrate, dried and weighed to find the amount of corrosion.

By a comparison of all the data made available through analyses of the soils used, etc., it was found that the amount of corrosion above a certain amount was practically proportional to the chloride content of the earth (in the form of sodium, magnesium or calcium chlorides). A certain amount of corrosion existed when the chlorine content was very small. The presence of the coal gas very markedly reduced the amount of corrosion of any sample of pipe over that of a similar sample in earth of the same locality.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—At the regular monthly meeting held on Nov. 12 at the Engineering Societies' Building, New York City, there was an exceptionally large attendance. President Hutton occupied the chair. Mr. Chas. R. Pratt, M. Am. Soc. M. E., delivered the paper of the evening, on his new positively-controlled, high-speed electric traction elevator (described in our issue of Sept. 26, p. 346). Mr. Pratt's paper was substantially along the line of our article.

Considerable interest has been manifested in Mr. Pratt's invention, both by the members of the society and by architects—a large proportion of the attendance at the meeting being architects. Much of the comment, formal and informal, has been skeptical.

Mr. Brown, of the Otis Elevator Co., maintained that in the ordinary electric traction elevator, properly equipped with oil buffers, the danger element—in the event of current failure—was very small, the usual safety devices being ample protection to passengers. He said, in effect, that, with the type of elevator originally designed for the Metropolitan Life tower, the inertia of the car and counterweight would, in the event of current failure, prevent rapid fall of the car—enough, that is, to exceed the shock-preventing capacity of the oil buffers. Mr. Pratt's reply to this, later, was an invitation to Mr. Brown to be aboard a car subjected to such conditions. Mr. Brown further pointed out that with an elevator speed of 600 ft. per min., suitable for express service and requiring a corresponding peripheral speed of the traction sheave—and consequently of the worm gear on its shaft—such as high speed would be necessary in the small controling motor driving the worm as to be impracticable.

Mr. Reginald Pelham Bolton, M. Inst. C. E., architect and civil engineer, of New York City, contributed written discussion. Owing to lack of time, it was necessary to postpone discussions from Messrs. Ihlder and Lindquist, of the Otis Co.; O. B. Humphreys, consulting engineer, of Bangor, Me.; and W. F. Hendry, of the Western Electric Co.

Mr. F. P. Ellithorpe made an informal plea for the bestowal of more attention, by elevator engineers and makers, upon the matter of safe doors, and automatic safeguarding devices therefor.

Mr. J. B. Mabbs, of Chicago, described, with the aid of lantern slides, an elevator invented by himself, capable, he stated, of a speed of 1,000 ft. per min.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—The November meeting was held in the auditorium of the Engineering Societies' Building, 29 West 39th St., New York City, on the evening of Nov. 6, with an attendance of several hundred. The much-discussed subject of electric operation of main-line railways was again brought forward at this meeting, Mr. A. H. Armstrong, of the General Electric Co., reading a paper entitled "Comparative Performance of Steam and Electric Locomotives." The major part of this paper was a carefully studied analysis of the operating characteristics of the steam locomotive. Special stress was put on the fact that the electric locomotive is able to exert its maximum drawbar pull at a much higher speed than can the steam locomotive. In fact electric locomotives of the kind discussed in the paper must be run at high average speeds in order to keep their power output within proper heating limits on long runs. In the steam locomotive the boiler capacity sets a limit to drawbar pull at relatively low speeds, 7 to 10 mi. per hr.; the electric locomotive can develop full adhesive pull up to speeds of two or three times as much. Therefore on mountain grade divisions, and especially where the profile is broken (so as to reduce the heating of the motors) the electric locomotive can haul maximum trains at speeds of 25 or 30 mi. per hr. where the steam locomotive averages but 6 to 8. The comparison is further modified by the elimination of frequent stops for coal and water, which on grade divisions especially reduce the average speed. The author concludes that great increase in traffic capacity of a given railway line is possible with electric operation, and in fact he puts this as the one dominant advantage of "electrification." He gave some calculations on economy of operation also, but frankly put these in a very minor place.

The paper developed an active discussion. Mr. W. J. Wilgus reported some operation figures of the New York Central & Hudson River R. R. New York terminal division, where electric service has been going on for the past year. The saving in engine repairs, including fixed charges, is about 19%. There is a saving of 4 hrs. labor per day, or 18%, in ordinary inspection and attendance (electric) as compared with cleaning, coaling, light repairs and the like (steam). The ton-mileage per locomotive shows an increase of 25%. The dead ton-mileage in regular schedule service is 35% with electric as against 51% with steam, a decrease of 16%; in switching service there is a saving of 11% in dead ton-mileage. The net operating result is that, counting all additional expenses involved in the electric service, the saving in (operating) cost is 12 to 27% in the summer months; a larger saving is looked for in the winter months. Besides, the capacity of the Grand Central terminal is increased one-third. These figures of course apply to very short-haul service, and a flat profile, and therefore supplement the author's claims for increased capacity on long mountain divisions. Mr. Wilgus believes that efficiency is just as strong a point for electric operation as is capacity. Incidentally, he remarked that the author's assumed power cost, ¾-ct. per KW.-hr. at the station, is too low.

Mr. Cary T. Hutchinson suggested that the steam locomotive, limited to say 50,000 lbs. per axle, can develop about 11,000 lbs. maximum and 9,000 lbs. continuous drawbar pull per axle, whereas no electric locomotive can reach this. But if an electric locomotive can be built for the same continuous pull (this will be at much higher speed), then its maximum pull will be so great that ruling grades are practically eliminated. On the question of different electric systems, he remarked that in a recently-computed mountain railway case, where he decided for three-phase, the railway officials had considered the fixed speed an advantage on down-grade work. The recuperation of energy with this system is also of importance in a comparison.

Of the rest of the extensive discussion, we note a remark by Mr. W. N. Smith, that operating questions would have a determinative influence on the question of track capacity, especially on single-track line. He believed that the author's estimates of increase would be entirely inapplicable to single track, mainly because the passing of trains, etc., is determinative in fixing schedules and operation, rather than the spacing of trains running in the same direction. The author replied to this, however, by asserting that it is precisely the single-track line which will permit of greatest increase of traffic capacity by the electric operation.

Among the other speakers we note Mr. W. S. Murray (N. Y., N. H. & H. R. R.), Mr. N. W. Storer (Westinghouse), Mr. Wm. McClellan and, Prof. C. L. de Muralt. The general trend of their remarks was in support of the author's claims for capacity as a vital point of advantage of electric operation, though opinions were also expressed in favor of the importance of cheaper operation.

ENGINEERING LITERATURE

Supplement to ENGINEERING NEWS. November 14, 1907.

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EDITORIAL.

Giving Credit for Drafts on the Literary Work of Others.

In every technical article of value, if the author has studied the available information upon his subject, frequent use is made of material which has been previously published. The experienced writer, in such cases, always gives proper credit, either in a prefatory note or in the text, to the source of his information. There have lately appeared, however, several books in which whole pages of text and numerous drawings have been either cribbed entirely or reproduced with apparent alterations. Inasmuch as unfavorable comments upon such practices, made in the columns of Engineering News, do not appear to be fully understood by some, it seems appropriate that we should outline what we consider to be the ethics of literary reproduction.

As a first principle, in any literary work, technical or otherwise, the laws of honest dealing require an acknowledgment of borrowed matter. A man's literary productions are as much his property as his real estate, and in many instances are protected by a copyright which precludes their use by any one but the owner, as effectively as does a deed or title to a city lot. When such legal protection is not invoked, as is the case in the greater part of periodical technical literature, it is because the author or editors think that the matter may be of general interest, and for that reason those so desiring it should not be put to the trouble of obtaining specific permission to reproduce it. The absence of such legal requirements does not change the ownership of the material or remove from the author the right to be credited for his labor.

There are many men whose only aim in literary production is to disseminate knowledge. Such men have no especial personal pride in their work, except for the work's sake, and are indifferent as to proper recognition by others who copy their material, so long as the theory which they have evolved or the information they have collected is given to the world. In such cases the burden of responsibility rests upon the one who copies. Any unacknowledged statement in a book is assumed to be the work of the author, and, even if the originator is indifferent, the one who repeats it owes it to himself to disclaim the authorship and to give credit where it is due. It is a poor sort of a man who parades another man's work as his own.

But aside from the attitude of common honesty there is a phase of the matter equally as important if not so obvious which holds in technical reproductions. That is the necessity of pinning every fact down to its original source so that the future investigator can have the benefit of original research, if he so desires. The technical periodical is an expression of the growth of the professions it represents. More than any technical book does it contain the working out of the daily problems of some branch of technology. It is the exchange place of new ideas. Necessarily from time to time certain men, better versed in a particular branch than their fellows, feel called upon to write a book on that subject. This book will be a compilation of the results of the author's experience and study, which study must be largely from the experiences of other men recorded in some printed form. No man can cover in his own experience the entire ramifications of any subject, however small it may be. Therefore he must draw on the periodical publication which is the principal medium through which past experience may be given out, and as the matter there published must be more detailed and discursive than can be compacted into the narrow confines of a general treatise, he can only draw in part or in abstract. However, the student may care to go further in his special investigations than the author could publish in the broader book. To bring his book, therefore, to its highest use it is incumbent upon the author to record each authority and reference, to label the source of every piece of knowledge other than those of the most general nature. It is understood, of course, that the line must be drawn somewhere or else our books would be nothing but masses of references to past work. Where the information is the property of any one who cares to investigate, such as is found in the news columns of our daily papers, or a matter of general knowledge in the present state of the art or even the simultaneous publication of several books or papers, it is unnecessary that its origin should be noted. When it is a matter of exclusive publication, or an idea of original discovery, the needs of the future student require that the source should be shown.

As an illustration of the extent to which this practice has gone we call to mind a recently published English book in which nearly half of the material is taken from American periodicals, no credit being given in any instance, though the matter is frankly a compilation and the author is most punctilious in acknowledging his debt to the few European publications from which he has drawn. In one instance, particularly, he reproduces, with his own style of shading and lettering, certain sketches made originally in the office of Engineering News by members of its staff; sketches which have no resemblance whatsoever to any other existing drawings. In view of the fact that a portion of his material is duly accredited to its proper place the only deduction of the reader, ignorant of the true facts of the case, is that the remainder of the work must be original. In addition to the dishonest impression hereby given, how much more valuable would be the book if the reader who wishes to pursue the investigation could get hold of the matter as originally explained in full in the much more detailed accounts of the technical press.

CASTINGS.—A Journal of Foundry Practice. Vol. I., No. 1, October, 1907. Cleveland, O.: The Gardner Printing Co. Paper; 9 × 12 ins.; pp. 48 + 26; illustrated. $1 per year; single copies, 15 cts.

The first number of this new journal treats many sides of foundry practice in a way that should please a superintendent, a foreman or an ambitious workman. That is to say, the articles contain enough merit to be worth reading and are treated in a style popular enough to attract these men. In this number are articles on foundry construction and arrangement, slags, the cupola, pattern-making, core molding, physical properties of irons, simple metallurgy, foundry practice, accounting and cost keeping. Between articles and for rounding out pages are the usual bits of condensed wisdom, epigrams, and short notes.

REVIEWS.

American Gas-Engineering Practice.

Reviewed by WALTON FORSTALL* and CHARLES J. RAMSBURG.†

HANDBOOK OF AMERICAN GAS-ENGINEERING PRACTICE.—By M. Nisbet-Latta, M. Am. Soc. M. E. New York: D. Van Nostrand Co. Cloth; 5½ × 8¾ ins.; pp. 466; numerous text illustrations and tables. $4.50, net.

The author begins his preface with the statement that "American gas engineers have for a long time deplored the lack of a work treating on the technology of modern gas supplies from a practical standpoint, and framed in such a manner as to constitute a book of reference for those engaged in the industry as well as for students." The American gas engineer has apparently been so fully occupied in keeping pace with the demands of a rapidly increasing industry that he has not stopped to record the status of his art. For any wrtiten information in relation to his profession, outside of the pages of the American gas journals, he must turn to books bearing a foreign imprint and describing foreign apparatus and tools.

Therefore, the announcement of a forthcoming American gas handbook was received with pleasant anticipation of the possible benefits accruing from such a work, although the author was not generally known in the profession. Now that reality has succeeded to promise, the wonder is how author and publisher alike could have been willing to father the work.

The book is divided into three parts: Water Gas Manufacture, 134 pages; Gas Distribution, 132 pages; and General Technical Data, 194 pages. It will be seen at once from these headings that the manufacture of coal gas is not touched on. In view of the large amount of coal gas made in America, the limitations of the book should have been indicated in the title.

Water-Gas Manufacture is sub-divided into eleven chapters, as follows, the numerals indicating the number of pages in each chapter: The Generator, 35; the Carburetter, 17; the Superheater, 3; Wash Box and Tar, 8; Scrubbers, 3; Condensers, 5; Purifiers, 20; Exhausters, 20; Station Meters, 10; Holders, 9; Details of Works' Operation, 5.

A standard work on water gas practice has long been needed. The field, however, is very vast and much remains to be done before a book could be written with any pretence of being complete. The contents of the eleven chapters named above cannot be considered as even a start towards the desired goal. It is obvious that the basis of knowledge was a poorly compiled scrap book, and that the most rudimentary principles of water gas manufacture are a sealed book to the writer.

Lack of space admits of allusion to only a few of the vast number of errors in this section. Under "The Generator," after discusing various features of the method of blasting, the following absurd explanation of a very ordinary phenomenon is given:

> The rate of flow of the blast being insufficient in pressure to carry away from the generator the CO first produced by combustion, and which should be burned to CO_2 by the additional air supply provided by the carburetter and superheater, furnishing fuel respectively to these parts of the apparatus, a large portion of the product remains inertly in the generator and is gradually burned from CO to CO_2, or, in other words, the complete combustion of C to CO_2 takes places in the generator instead of being distributed through the apparatus.

In the chapter devoted to the Carburetter, among other wonderful statements, it is said that "B. S." is another name for Crude Oil. This is trivial, but denotes an astonishing lack of practical knowledge of the subject

In speaking of the steam supply, the fact is brought out that in water-gas manufacture, there is a tremendous loss due to excess steam. It is shown that with 1,000 cu. ft. of gas there is an

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excess of about 100%, or that nearly 8,000 B.T.U. are lost by this alone. It is a pity the writer did not carry the deduction further and show that this means about .7-lb. of coal at the most, while the loss due to the presence of 1% of CO in the waste gases is equivalent to almost as much as this, and that it is safe to say that in nearly every gas works in the country the loss from this item alone is probably five times this. This feature is ignored entirely.

Under Condensation, there are many absurd statements. Valuable vapors, it is said, are removed from the gas by being "squeezed out" by sudden contraction, as one would wring out a sponge. The phenomena of vapor tension is entirely ignored, though later in the book, tables are given which show that the knowledge was at hand. We are also told that Naphthalene troubles can be avoided by the removal of the moisture from the gas. This is an old and long discredited myth.

Under Purification, the most important improvement in years, namely, the Tutwiler Burette for determining the H_2S present at any point in the system, is entirely overlooked, and a method advocated which is far behind modern practice.

Taking the portion devoted to water gas as a whole, there are many extracts taken verbatim from papers read before various associations and from answers of the Trustees Gas Educational Fund, which cannot fail to be of value, but these instalments are so mingled with the author's absurdities as to make the whole a dangerous work to which to refer for any real information.

Gas Distribution is sub-divided into chapters as follows: Naphthalene, 7; Mains, 58; Services, 27; Consumers' Meters, 7; Pressure, 20; House Piping, 13; Appliances, 17.

Right at the start of the distribution section is one of the many examples of bad arrangement of matter with which the book abounds. Why put Naphthalene as a chapter under Distribution, is a query that most gas engineers would raise, even before they know that most of the chapter referred to manufacturing details. However, this fault is trivial compared with the jumble of mistakes, contradictions and repetitions that mark page after page of the distribution section. It is too plainly evident that no thought has been given to an orderly arrangement of the various subjects naturally falling under the chapter headings chosen. Under Mains, service matters are touched on; under Services, main data given; and under Pressure, a description of some high-pressure apparatus, although the subject of high-pressure distribution has been treated of under Mains. Given a good memory, bad arrangement need not mean repetition; given a knowledge of the subject, it will not mean contradiction; but in this book it has meant both. A few instances from many must suffice.

Pole's formula is given on page 142, and again on page 377, and in neither instance is the value of "H" correctly defined. Dr. Robinson's formula is also repeated on the same pages, and a comparison of the definition of the same dimensions, as given in the two places, is a fair illustration of the careless editing abounding. On page 157 is repeated a statement as to the quality of pipe for high-pressure work, already given on page 154. On page 201, under a paragraph entitled "Coating," these words appear:

> The question as to whether or not wrought-iron service pipes should be coated, depends largely upon the character of the soil through which they run. It is certain, however, that in the neighborhood of ice-cream saloons, fish markets and localities where the pipe must be exposed through areaways, etc., galvanized iron should be used.

Previously, on page 163, under "Service Connections," the author had written:

> It is doubtful whether under any conditions it is good economy to use galvanized pipe for services, inasmuch as nearly all agencies which tend to destroy black iron will also attack the zinc coating of galvanized pipe. Medium weight steel pipe will be found far better.

Picture the difficulty of the learner trying to reconcile these two statements.

There are many general statements which are either entirely untrue, or need decided qualification. Among such are: On page 143, "It is economical and good practice to lay as long a line as possible without putting in drip pots"; on page 144, "The viscosity of the condensation (composed largely of tar and other oily ingredients) is so great," etc.; on page 162, "The entire system of every gas company should be periodically barred"; on page 163, "A malleable point for a leak bar is recommended in order to prevent injury to the main." As most barring for leaks is done through frozen ground, the fate of the malleable point is not difficult to imagine.

The plates giving dimensions for pipes and specials, as adopted by the American Gas Light Association in 1905, are given on pages 182 to 199, with no proper heading, a number of typographical errors, and a total lack of suitable arrangement. Had the author kept in touch with gas association work, he never would have printed these plates in 1907, without making the corrections which in 1906 had been pointed out as necessary.

The chapter on Consumers' Meters gives very scant treatment to what is the most important branch of distribution work, but though short it is replete with errors. On page 209, the capacity of a three-light meter is given as 54 cu. ft. per hr. On page 210 it is given as 40 ft. with .3-in. loss, and on page 213, the allowable loss of a meter is given as .2-in.! The various meter tests are badly described and wrongly named. Lead connections are recommended for meters of certain size; nevertheless iron pipe sizes are also given. The only illustration of an iron connection is for a meter with flanged connections.

Throughout the work are page after page of extracts from various sources, the principal source being the answers sent out to the classes in gas engineering conducted by the Trustees Gas Educational Fund. An especial acknowledgement of his great indebtedness to this one source would have been a graceful act on the part of the author, but perhaps not to be expected from one who begins "House Piping" with a very complete set of specifications, but who neglects to state that it is taken verbatim from Philadelphia. Then follows another set of specifications, taken presumably from some other city, with never a word to indicate what the good points of each specification might be.

In the chapter on Appliances, ignorance is again displayed throughout, not only by what is said, but also by what is omitted. For instance, water heaters and gas heating stoves are unnoticed. The statement is made that flashing back is caused by "a preponderance of gas, or insufficient air." This is absolutely wrong.

General Technical Data is sub-divided into chapters with pages as follows: Properties of Gases, 45; Steam, 30; Mathematical Tables, 37; Conversion Factors, 9; Pipe and Miscellaneous Data, 83. A cursory examination would indicate that most of this information is contained in handbooks apt to be in the possession of a gas engineer, and some of it should have been placed in other parts of the book.

The sweeping condemnation of any work should ever be unpleasant and not lightly done. Nothing else seems possible, however, in the case of this book, and gas engineers should be prompt to disavow it as representing to any appreciable extent "American Gas Engineering Practice."

TABLES FOR ENGINEERING CALCULATIONS.—By Richard C. Powell, Assoc. Am. Inst. E. E. Second Edition, revised and enlarged. Berkeley, Cal.: The Author. Flexible leather; 4½ × 7 ins.; pp. 195; illustrated. $2.

This volume is one of the attempts to supply the need for a general handbook small enough to be easily carried about in the pocket. Whether or not such a book has fulfilled the compiler's intentions is largely a matter of individual experience. That this book is a second edition seems to indicate that it has been found useful to many engineers.

In its rewritten form it contains sections on logarithms, trigonometric functions, circles, functions of natural numbers, conversion tables, wire and sheet metal gages, hyperbolic functions, solutions of equations, integrals, plane curves, probable error, properties of sections and solids, strength of materials, columns, beams, on the atomic weights of elements, density, heat tables, magnetic and electrical constants, properties of wires, cables and transmission lines and on hydraulics.

The greater part of the book is made up of tables of numbers, and as the printing was done in a newspaper establishment the compiler should have informed the users of the volume as to what pains were taken to guard against typographical errors. Not knowing this, the user is apt to base any discrepancy in his computations on errors of the tables, whether they exist or not.

TURNEAURE and MAURER
Principles of Reinforced Concrete Construction
8vo, viii + 317 pages, 11 plates and 130 figures. Cloth, $3.00.
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FOWLER'S MECHANICAL ENGINEER'S POCKET BOOK, 1908.—Edited by William H. Fowler, M. Inst. C. E. M. Inst. M. E. Tenth Annual Edition, revised and greatly enlarged. Manchester, England: Scientific Publishing Co. Leather or cloth; 3¾ × 6¼ ins.; pp. 83 + 675; illustrated. Leather. 2s. 6d.; American price, $1. Cloth, 1s. 6d.; American price, 60 cts.

The 1908 edition of this familiar annual presents, as usual, a handy compendium of engineering data at an absurdly low price. The general arrangement is superior to the previous editions, as much material that was scattered has been grouped. Additional matter has been inserted on mechanical calculators, weldless chains, strength of piers, steam engines and boilers, pumps and pumping machinery, chimneys and draft. Some material on machine tools and machine processes has been omitted, but as such parts were rather meager the loss is more than compensated for by the additions.

THE JOURNAL OF THE IRON AND STEEL INSTITUTE.—Vol. LXXIII., No. 1, 1907. Edited by Bennett H. Brough, Secretary. London, England: E. & F. N. Spon, Ltd. New York: Spon & Chamberlain. Cloth; 5½ × 8¼ ins.; pp. 638; folding and other plates, and text illustrations.

This volume contains, among other technical papers, the following of especial interest: "Development of Electricity in the Iron and Steel Industries," by D. Selby Bigge; "An Investigation on the Use of Steam in Gas-Producer Practice," by W. A. Bone and R. V. Wheeler; "Relation between the Process of Manufacture and Some of the Physical Properties of Steel," by F. W. Harbord; "The Ageing of Mild Steel," by C. E. Stromeyer; "Sentinel Pyrometers and Their Application to the Annealing, Hardening and General Heat Treatment of Tool Steel," by H. Brearley and F. C. Moorwood; and "Carbon Tungsten Steels," by T. Swinden.

Section II. of the volume—about 275 pages—is devoted to notes on the progress of the iron and steel industries of the world, statistics, etc.

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The British City of To-Day.

THE BRITISH CITY.—The Beginnings of Democracy. By Frederic C. Howe, Ph. D., Author of "The City: The Hope of Democracy," "The Confessions of a Monopolist," etc. New York: Charles Scribner's Sons. Cloth; 5¼ × 8¼ ins.; pp. xvi. + 370. $1.50.

The British municipality is here exhibited in a new light. Heretofore it has either been held up to Americans as a shining example of all that is good in municipal government or else, and that but recently, as a most horrible example of the evils of municipal ownership. Mr. Howe, while giving high praise to the purity and business efficiency of municipal administration in Great Britain, and while devoting a large amount of space to facts and arguments in support of the success of municipal ownership in that country, nevertheless finds much to condemn. The condemnation, however, applies to sins of omission rather than commission, and these sins are laid on the shoulders of land and public-service franchise owners rather than upon municipal officials.

The land and franchise owners control Parliament and Parliament controls the municipalities. Moreover, the municipal franchise is virtually confined to taxpayers [ratepayers] and the taxes are assessed on householders or renters. All land and most buildings being free from taxes the latter fall heavily upon occupiers. Consequently the taxpayers are very sensitive as to municipal taxation and jealously watch the acts of municipal officials. In the hope of reducing taxes through profits, from the water, lighting and street railway services, so Mr. Howe's argument runs, and also because of a belief that the city gives him better service than a private company, the British taxpayer demands and gets municipal ownership. But where such ownership means acquisition by purchase it entails an enormous cost, owing to Parliamentary restrictions in favor of franchise owners. Likewise, there is an enormous burden to be assumed by a city if it acquires land for street widening or for the destruction of unsanitary buildings, since the purchase terms are controlled by Parliament and assessments against landowners for betterments are not made, as is the invariable rule in this country.

The foregoing statements will give the reader of this notice a general idea of both Mr. Howe's viewpoint and of some of the leading conditions governing municipal activities in England and Scotland. To give a still clearer and far more vivid and interesting picture of Mr. Howe's general attitude we will quote a few paragraphs from his Preface, first reminding the reader that the author bases his whole study, as also in his earlier book, dealing with the American city,* on the relation of the city to democracy, or government for and by the people. We quote as follows:

> We are coming to see that the city can only relieve itself from the burdens under which it labors when its physical foundations are under the control of the community rather than in private hands.
>
> The British city confirms this conviction. For the British city is free from corruption. Its organization is simple, direct, democratic. The members of the Town Councils are responsible and responsive to public opinion. The suffrage is limited to the tax-paying class. There is no boss, no machine, no spoils system. Great Britain has achieved what we in America have long prayed for. Her local politics are in the hands of her business men.
>
> Yet poverty is at its worst in the British city. Millions of people are herded in tenements unfit for the stabling of horses. An equal number are ever hovering on the border line of pauperism. So far as human welfare is concerned "good government" is not enough. Mere honesty is not enough. The calling of business men to the Town Councils has not relieved the terrible costs of the modern city. The life of the people, their standard of existence, the condition of their homes, their health, education and happiness is a matter of something more than honesty and efficiency.
>
> In the British, as in the American city, Democracy is chained, Prometheus like, by economic fetters. The people enjoy political freedom. But political freedom has achieved as little as honesty. The British city is under the servitude of an economic master. It is ruled by the members of Parliament, and especially by the House of Lords, which has no sympathy with the ideals of democracy. For democracy is seeking to destroy the privileges which the members of Parliament enjoy. All of the physical foundations of the city are in alien hands. And those who own these privileges and are responsible for their abuses are as indifferent to the needs of humanity and as arrogant in their oppression of the people as the boss of any American city. In Great Britain, as in America, conditions are the same. Human welfare is subordinate to property. Those who suffer from the abuses of privilege are denied the power to correct them. Despite its unquestioned honesty and efficiency, the British city remains the ward of its feudal master, Parliament.

Having given so much space to the general character of the book little will be said of its contents in detail. The author traces the beginnings of democracy in the British city and outlines municipal government, in practice and as an ideal, as it there exists. He devotes a number of chapters to "Municipal Trading," or what we here call municipal ownership. These chapters might profitably be read in connection with three books against municipal ownership in England, reviewed in these columns within the past year or so,* Two chapters are used to exhibit Parliament as a tyrant over cities and as "the sanctuary of privilege," and one chapter to describe "the dead hand of the land." Glasgow, "A City of Thrift and Conscience," and London, "A Municipal Democracy" (meaning the Greater London of the County Council) are each given a chapter, as is also "The Municipality and Labor."

We trust we have said enough about this book to make it evident that no one interested broadly in the bettering of municipal conditions, in the municipal ownership controversy, in taxation and in the uplift of that large portion of humanity now resident in cities can afford to let the book get very much older before giving it an attentive reading. So earnest and well-purposed a book deserves respectful consideration even by those who disagree with the main theses of the author. For our part, we believe that in his main principles the author is right, as also in many of his applications of those principles to judge the success or failure of the British city. We also believe that he carries some of his theories too far, and that he sometimes denies, although unintentionally, property holders the very rights to control legislation in their own interests that he so urgently claims for those who are blessed with little or none of this world's goods.

In conclusion, two minor points which deserve correction or elucidation may be noted: (1) It is far from true that no British city can borrow money for any purpose without permission from Parliament. Money for a wide range of municipal works can be borrowed on approval of the Local Government Board, only. (2) The author, with possible profit to both himself and his readers, might have ascertained and set forth why British cities in general and London in particular have so low a total death rate and so much freedom from many communicable diseases, notwithstanding the poverty and in spite of the overcrowding and allied unsanitary conditions that he so much and so rightly deplores.

HOW TO LAY OUT SUBURBAN HOME GROUNDS.—By Herbert J. Kellaway, Landscape Architect. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 6 × 9¼ ins.; pp. 112; illustrations, maps and plans. $2.

A rather meager but otherwise satisfactory text accompanies a considerable number of illustrations, mostly half-tones, all designed to give, in language readily understood by any householder, some of the essential principles that should govern in laying out small home grounds, from both the esthetic and utilitarian viewpoints. The author properly begins with suggestions regarding the choice of the building site. He gives directions for simple elementary methods for a topographical survey of the plot, and discusses such practical points as the building of driveways and concrete walks and the making of lawns. Of course particular attention is given to the selection of shrubbery, trees and the like,

*"The City: The Hope of Democracy." Reviewed in this Supplement, Dec. 14, 1905.

*"Municipal Ownership in Great Britain," by Prof. Hugo R. Meyer; Aug. 16, 1906. "The Dangers of Municipal Ownership," by Robert P. Porter, and "On Municipal and National Trading," by Lord Avebury (Sir John Lubbock), May 16, 1907.

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and their proper disposition for the best effects. The book is well worth possessing by any one owning the smallest house and grounds, and might be serviceable to people who rent houses, notwithstanding the truth of the following quotation from Arthur Young at the head of one of the chapters:

Give a man the secure possession of a bleak rock, and he will turn it into a garden; give him a nine years' lease of a garden and he will convert it into a desert.

The book might also be of service to engineers in the smaller towns, who are sometimes called upon to assist in the development of home grounds.

The Art of Raising Money.

FINANCING AN ENTERPRISE.—A Manual of Information and Suggestion for Promoters, Investors and Business Men Generally. By Francis Cooper. In Two Volumes. New York: The Ronald Press. Cloth; 5¼ × 8¼ ins.; pp. 543. $4; either volume singly, $2.

This book is on a subject concerning which few, if any, books have been written and very little published anywhere. It relates to the field of business; and in this field it has not yet become customary to set down in systematic treatises the available knowledge concerning a given line of work.

There is no reason, however, why commerce and finance should not have as systematic and useful treatises as the professions have long possessed. The work of financing an enterprise, a railway for example, is just as important, just as necessary to the community, and far more difficult than the work of locating the line of the railway upon the ground. The work of the promoter generally precedes the work of the engineer, and is indeed a necessary prerequisite thereto. It is true that promoters, as a class, are in bad odor in the business and financial world. The man with a new enterprise, with stock to sell, or bonds to float, is deemed prima facie to be a suspicious person. Yet every enterprise, large or small, has to pass through its promotion stage. Somebody somewhere must bring together the opportunity for the establishment of a profitable industry and the capital necessary to place the industry in operation. Without the promoter, no railways would be built, no mines opened, no banks established, no manufactories would have their whee's set turning, except as isolated individuals had themselves the capital to undertake such works.

Without the promoter, the accumulations in savings banks and life insurance companies would be idle for lack of employment.

We cannot get along without the promoter, but it is highly desirable that the business of promotion should be put on a more honest and honorable basis.

In the book before us the business of promotion —or "financing an enterprise"—is described in detail, and in a very intelligent and readable manner. The author freely recognizes, at the outset, the parlous state into which the "promoting" business has fallen. The reason why it is a difficult matter to finance an enterprise, he says, is that

a large proportion of the enterprises brought forward are in the hands of young or inexperienced men, overly enthusiastic and sadly lacking in judgment; of inventors, often mentally loose-jointed and wildly impracticable; of unsuccessful business men warped by their reverses and snatching at straws; of promoters, more or less unscrupulous and unreliable; of adventurers without money or reputation, and anxious only to turn a penny without regard to the means employed.

This condition, however, ought to furnish all the better opportunity for success to the really honest, competent, and reliable man who takes up the business of promotion.

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Engineers who have to do with patented inventions and their commercial exploitation will also find much instructive and helpful matter in this treatise.

SHAFT-SINKING UNDER DIFFICULT CONDITIONS.—By J. Riemer. Translated from the German by C. R. Corning, Mining Engineer, and Robert Peele, Mining Engineer and Professor of Mining, School of Mines, Columbia University. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5½ × 9¼ ins.: 18 illustrations in the text and 19 folding plates. $3.

In our issue of Aug. 15, 1907, p. 178, we reviewed another translation by an English engineer of this same German work. This American translation naturally presents the matter essentially the same as does the English work, but with certain minor differences worth noting. In arrangement of text-matter, the English translation has an advantage in that frequent side-captions facilitate the general grasp of the subject by the reader. But the phraseology of the American work is better adapted to American readers, both in the direction of arrangement and of the selection of words. English industrial terminology includes many coined words—largely the slang of workmen—which are often unintelligible to Americans. These are so put in the translation here reviewed that American readers will not find it necessary to use a glossary. It may be added that cost figures are given in dollars and cents, whereas in the other translation they occur as pounds, shillings and pence. The slight advantage of larger type in the American translation may also be noted. In the back of the book are bound the same folding plates, or "working drawings," that add so much to the value of the original and the English translation.

STANDARDIZATION RULES OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—Approved by the Board of Directors, June 21, 1907; Accepted by the 24th Annual Convention, June 27, 1907. New York: The Institute (Ralph W. Pope, Secy., 33 West 39th St.). Cloth; 5¾ × 9¼ ins.; pp. 1,077 to 1,105. 25 cts.; paper, 10 cts.

The first step of the American Institute of Electrical Engineers toward standardizing electrical apparatus was a discussion on "The Standardization of Generators, Motors and Transformers," in New York and Chicago, Jan. 26, 1898. This discussion may be found in Vol. XV. of the Transactions. As a result of these discussions a Committee on Standardization was appointed, consisting of Messrs. F. B. Crocker (chairman), C. T. Hutchinson, A. E. Kenelly, J. W. Leib, Jr., C. P. Steinmetz, L. B. Stillwell and Elihu Thomson. By this committee, a report was presented in which appear the original rules. On account of the growth and development of the electrical manufacturing industry it became necessary to revise the first rules in 1902, and to attempt in 1905 a still further revision. The amended rules were submitted to the Board of Directors and approved in June, 1907. These rules now supersede those of 1902, which may be found in Vol. XIX. of the Transactions of the Institute. The matter has been entirely rearranged in a more logical and convenient form. The present form fills 29 pages while the 1902 form occupies some 18. This indicates to a certain extent the additions that have been found advisable. The present rules as published represent the work of several successive committees of the Institute, but the present form and arrangement is due to the "Standards Committee," which was made up as follows: Prof. F. B. Crocker (chairman), Prof. D. C. Jackson, Prof. A. E. Kenelly, C. O. Mailloux, Prof. R. B. Owens, C. F. Scott, H. O. Stott, C. P. Steinmetz, S. W. Stratton, Elihu Thomson.

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MINISTER OF MINES (BRITISH COLUMBIA).—Report for the Year Ending 31st December, 1906. Being an Account of Mining Operations for Gold, Coal, etc., in the Province of British Columbia. (Richard McBride, Minister of Mines.) Victoria, B. C.: Pub. Doc. Paper; 7 × 10¼ ins.; pp. 276; folding and other plates.

This comprehensive report, interestingly supplemented with reproductions of photographs illustrating the topographical and geological—not to say scenic—features of this picturesque

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mining region, and with geological maps also, will repay him who secures and reads it. The form of preceding reports has been followed closely, to facilitate comparison with information previously given.

French Suggestions for Reinforced-Concrete Girder Bridges.

RECUEIL DE TYPES DE PONTS POUR ROUTES EN CIMENT ARME.—Calculated in Conformity with the Ministerial Order of Oct. 20, 1906. By N. de Tedesco, with the collaboration of Victor Forestier. From "Encyclopédie des Travaux Publics," begun by M.-C. Lechalas. Paris, France: Ch. Béranger. Paper; 6½ × 10 ins.; pp. 307; 54 illustrations in the text; 8 folding plates in separate atlas, 10½ × 12¾ ins. 25 francs; American price, $7.50.

In October, 1906, the Ministry of Public Works of France issued a circular entitled "Instructions relating to the use of reinforced-concrete," (Engineering News, March 21, 1907, p. 319) which was primarily intended to serve as regulations for the government engineers but at the same time formed something of a standard for work to be executed in France. It is one of the few existing authoritative or official sets of rules to be followed in reinforced-concrete construction, and in contrast to many of the European government scientific utterances, it is remarkably simple in its details, always taking advantage of the clearest theory and avoiding much of the superrefinement often noticed in reinforced concrete design. With the above ministerial circular as a basis, Messrs. Tedesco and Forestier have compiled a series of designs of highway bridges in which the spanning members are reinforced-concrete beams. The work consists of a presentation of the government rules, with their application to the design of beams and slabs in a bridge and concludes with the detailed design of eight bridges varying in size from a single roadway 13 ft. (4 meter) span to a double roadway 98 ft. (30 meter) span. The methods of computation are presented in utmost detail, first for the general case and then in specific quantities for each of the eight designs. The entire mathematical design of each bridge is minutely detailed just as it would come from the hand of an experienced bridge designer; every step is shown. In the supplementary volume plates are given showing the details of each structure on a very large scale and in an entirely satisfactory manner.

The whole impression gathered from the work is that it is an example of too infinite detail. The value of the itemized design of one bridge of a type can be recognized; it would seem a needless repetition to go through the same procedure eight times over when the only variation lies in a small increase in sizes. Outside of the purely passing value that the tabulation of quantities has for an estimating engineer, there is nothing to be gained in knowing the exact minutiae of design of a 4 m., 6 m., 8 m., 10 m., 15 m., 20 m., 25 m. and 30 m. beam bridge. It is extremely unlikely that these exact sizes can be utilized by any designing engineer, for bridge engineering is not now as it once was in the days of the old iron bridge companies when, to quote a prominent professor of bridge engineering, "They decided upon the length of bridge required and then cut that length off a stock drawing, like so much calico." The theory developed in this book and its application to one span so as to indicate its use in practice are well worthy of appreciation. Tiresome repetition of the same methods on seven other spans seems a waste of energy both to author and reader.

Except that they are somewhat heavier, the designs for the smaller spans are in accordance with current American practice. Special care is taken with the placing and dimensioning of the web stirrups in all beams and connections between all separate members are well tied together. For all the spans up to 25 m. the designs presented may be well regarded as standards toward which to work. In the larger spans (25 and 30 m.), however, there is a departure from customary design which is, to say the least, bold. In each of the large girders on the 25 and 30 m. spans, large panels are cut away from the web, leaving only columns connecting an upper and lower chord at each floor beam. For instance, the 98.4 ft. (30 m.) girder is, in effect, an upper chord 2.6 ft. (0.8 m.) deep, a lower chord 0.8 ft. (0.25 m.) deep, with 9.8 ft. (3.0 m.) out to out of chords. These chords are supported by a 3.3 ft. (1.0 m.) column at each abutment and by ten 0.8 ft. (.25 m.) intermediate columns spaced 9.8 ft. (3.0 m.) c. to c. This gives the effect of a truss bridge with its diagonals removed. It is not exactly new in European circles, having been suggested some years ago for steel plate-girder bridges by Prof. Vierendeel, of Louvain University, but it is one that will hardly appeal to American engineers. The stresses are highly indeterminate and their transferral from upper to lower chord is dependent entirely upon the stiffness of connections between chord and vertical. In the application of this design in the present book the different conditions of stress, due to the peculiar make-up of the beam, are totally disregarded. All computations are made under the dead load of the reduced section as though for a beam solid throughout. No change is made in the assumption that compression passes directly to the upper chord and tension to the lower under the rules of the standard formulas prescribed by the official circular. The treatment of the stresses in the posts connecting the chords is particularly obscure. The saving in weight and material by such sections is enormous, but their use in concrete where the connections and consequently the stresses must necessarily be subject to doubt, can hardly be called sane design.

BULLETINS, OFFICE OF PUBLIC ROADS.—Logan Waller Page, Director. Washington, D. C.: Pub. Doc. Paper; 5¾ × 9 ins.

No. 29: The Construction of Macadam Roads. By Austin B. Fletcher, Special Agent, Office of Public Roads. Pp. 56; six plates and ten text figures.

No. 31: Examination and Classification of Rocks for Road Building, Including the Physical Properties of Rocks with Reference to Their Mineral Composition and Structure. By Edwin C. E. Lord, Petrographer, Office of Public Roads. Pp. 29; ten plates, one text figure and one folding table.

The first of these bulletins gives a very good idea of methods employed in constructing macadamized roads, especially as carried out under the direction of the Massachusetts Highway Commission. The stone used for macadam, the necessary stone crushers, road rollers, watering carts, and labor and team equipment, are briefly described. The important subject of drainage is briefly discussed, after which the preparation of the subgrade and the placing of the macadam itself are taken up. An appendix gives extracts from the specifications used in roads built by State aid in Massachusetts, New Jersey, New York, Connecticut, Pennsylvania and Maryland. There are also given cost data for Massachusetts and New Jersey, and drawings of culverts of stone, of reinforced concrete and of wood.

The second pamphlet is decidedely technical in character as compared with the first one, but for

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This is a sample of the welcome that Gilbreth's "Field System" has received. The advertisement of Gilbreth's "Field System" will be found elsewhere.

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engineers and others who wish to go thoroughly into the science of macadam-road building materials it contains information of much value. The author describes a microscopic method of rock analysis, outlines the characteristics of various kinds of rocks, and gives in tabular form "the average mineral composition and physical properties of all rocks" thus far examined by the Office of Public Roads. The author states that since December, 1900, analyses have been made of more than 1,500 rock samples from nearly every State in the Union, as well as from Cuba, Porto Rico and Hawaii.

New Editions of Two Standard Electrical Books.

Reviewed by HENRY H. NORRIS.*

STANDARD POLYPHASE APPARATUS AND SYSTEMS.—By Maurice A. Oudin, M. Am. Inst. E. E. Fifth Edition, revised and enlarged. New York: D. Van Nostrand Co. London, England: Sampson Low, Marston & Co., Ltd. Cloth; 5 x 8 ins.; pp. 369; 207 illustrations in the text. $3, net.

KURZES LEHRBUCH DER ELEKTROTECHNIK.—By Dr. Adolf Thomälen. Third edition. Berlin, Germany: Julius Springer. Cloth; 6¼ x 9¼ ins.; pp. 525; 338 illustrations in the text. 12 marks; American price, $4.80.

The vitality of Mr. Oudin's treatment of the subject of alternating-current engineering is attested by its continued popularity. In eight years five editions have been issued. This has given the author the opportunity to keep the book up to date, a difficult matter in the field covered. One reason for the large sale has been that the topics are discussed from the practical standpoint by an engineer who is in daily touch with the apparatus which he describes. Further, the text is almost free from mathematics, a remarkable feature in a book of this character. It is, however, not a book for beginners, but is suited particularly to the needs of those who have some degree of familiarity with the apparatus described. The author does not confine himself exclusively to the field covered by the title, but takes up also some problems of single-phase apparatus. For example, in the chapter on induction motors a liberal space is given to single-phase motors of the variable speed type. It would be almost impossible to discuss polyphase equipment without to some extent covering the other.

The book comprises main divisions on generators, motors, transformers, converters, switchboards, and transmission. A brief introductory chapter summarizes the definitions of alternating-current terms, following which are two chapters on generators. In these as well as in the following chapters, examples of typical machines are illustrated and briefly described. The principles underlying generator operation are treated in a very practical manner under such headings as field excitation, compounding, regulation, efficiency and losses, power factor, speed, parallel running, etc. Many interesting numerical examples from practice support the general statements, and the dimensions and performance of successful machines are used to illustrate modern construction and operation. Curves of efficiency, losses, regulation and other variables obtained from actual test are an important feature. In the three chapters on induction and synchronous motors the same program is followed and a simple explanation of the action of the series alternating-current motor is included. The present interest in heavy electric railway work, to which this motor is chiefly applicable, renders this insertion timely, although somewhat outside the polyphase field.

In the chapter on transformers the author states that the prejudice in this country in favor of separate transformers on polyphase circuits is diminishing, and that polyphase transformers are used in increasing numbers. The latter are preferable in large installations on account of the lower cost and the smaller floor space occupied. In this chapter are descriptions of present types of transformers. Their operation is subdivided into efficiency and losses, regulation and parallel operation. The general reader will derive helpful suggestions from the author's statements regarding apparatus for changing the variety of current, namely, rotary converters, motor-generators and rectifiers. To an increasing extent electric power is produced and transmitted in a more or less standard form, to permit the use of large units economically loaded. General practice seems to incline toward three-phase 25-cycle current at voltages from 10,000 to 80,000. As the needs of the individual customers are varied it is necessary to transform the power in substations. The selection of the proper apparatus for this purpose requires judgment and experience. Mr. Oudin's suggestions will assist in this direction. The latter part of the book contains information regarding power transmission and the apparatus necessary therefor. This involves switchboards, lightning protection, protective devices, the transmission line and the general theory of polyphase currents. These are all covered as thoroughly as the space will permit.

As a whole the book is readable, interesting and stimulating. It is not as theoretical as Dr. Thomälen's book, reviewed below, nor is it unnecessarily elementary. It contains numerous practical data and the author has evidently endeavored to give the book perspective by showing the inter-relation of the various parts of a polyphase equipment.

A student of the reviewer recently wrote to one of his former professors at The Hague, Holland, inquiring as to the best recent books on electrical engineering. The reply contained the statement that Dr. Thomälen's "Elektrotechnik" is accepted in Europe as a standard text. The first edition was published in 1903, so that the demand for the book has been considerable to call for a third edition so soon. As stated by the author in the preface to the first edition, the work occupies a place midway between popular and special treatises. It is of a general and comprehensive nature, but is not a descriptive text on the one hand nor a highly mathematical one on the other. Algebra and geometry are, however, freely and naturally used wherever necessary for conciseness and accuracy. The text is prepared with characteristic German thoroughness and the topics are arranged systematically and logically. By means of condensation of the text, and the use of close printing, thin paper and large pages a remarkable amount of material is contained in a volume of convenient size and reasonable price. In these respects it differs from many of the recent books issued in this country. The illustrations are diagrams of circuits and parts of machinery, and curves of various kinds. They are all line drawings, reproduced clearly, giving the pages a neat and uniform appearance. Views of actual machines, requiring the use of half-tone illustrations, are not necessary on account of the scope of the work. The reader must be familiar with the appearance of the apparatus from observation in order to benefit by the author's discussions.

The material in the book consists of 137 sections or topics, each as nearly self-contained as possible. These are arranged in 20 chapters covering the entire range of the theory and applications of electrical machines and circuits. The topical arrangement employed is excellent for reference purposes, as it enables the reader to find a desired subject with minimum difficulty. As typical of the general plan the chapter on transformers will serve for illustration. The first topic is the e. m. f. induced in the windings, followed by a clear exposition of the magnetizing current. Curves show the relation of induction density, permeability and energy loss per unit weight. A simple vector diagram gives the phase relation of the magnetizing current to the line and counter e. m. f. s. An excellent section covers hysteresis loss with practical numerical illustrations. Long sections are devoted to the performance of the transformer with non-inductive and inductive loads, the explanations being accompanied by vector diagrams, algebraic formulas and numerical examples. The chapter closes with a discussion of magnetic leakage and its effect upon regulation.

In comparing this work with Mr. Oudin's it may be said that it deals more with underlying theory, while the other treats chiefly of operation. It is suited more particularly to the needs of the specialist in electrical engineering, while Mr. Oudin's book will be intelligible to any one who is reasonably familiar with electrical machines. Dr. Thomälen's book, while properly devoting the larger space to alternating-current theory, also treats of the elements of commutation and other important problems of direct-current apparatus.

*Professor of Electrical Engineering, Cornell University, Ithaca, N. Y.

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REMCO'S MANUAL OF APARTMENT HOUSE SERVICE.—New York: The McClure Co. Cloth; 4¼ x 6¾ ins.; pp. 327; illustrated. $1; mail, $1.10.

To the apartment house dweller scanning the pages of this book—i. e., the person who has been "up against" the average apartment house as found in our larger cities, more particularly New York and Chicago—the thought is apt to occur: What a paradise apartment life would be if this book were widely circulated and its contents enforced!

Under "General instructions" (to the janitor, and to all of his subalterns—elevator boys, telephone operators, etc.), there are rules applicable to every contingency apt to arise in an apartment building from the rising of the sun unto the going down thereof—with special rules for nocturnal use.

Such details as the conduct of heating apparatus, the eradication of vermin, etc., receive especial notice. Thirty-four pages on the technicalities of elevators, and 50 on steam and hot-water boilers make for additional security to the apartment dweller—where the janitor reads and heeds this book.

The last hundred pages are devoted to other engineering and sanitary details about the apartment house. This engineering material is a compilation of extracts from the "Literature" of such companies as the American Radiator Co., the Otis Elevator Co., etc. A chapter on electrical machinery, by Henry Floy, Assoc. Am. Inst. E. E., is worthy of note.

TRAVELERS RAILWAY GUIDE.—Eastern Section. (Successor to Appleton's and the Travelers' Ready-Reference Guide.) Pocket Edition of the Official Railway Guide (By Arrangement with the National Railway Publication Co.) Issued monthly. New York: Knickerbocker Guide Co. (24 Park Place). Paper; 5¾ x 8 ins.; pp. ccxxii. + 344; illustrated. 25 cts. per copy; $2.50 per annum.

The 50th anniversary number of this well-known handy guide is marked by the reproduc-

C. E.

The civil engineer who aims to succeed when in responsible charge of men should study the system employed by some successful manager. "Field System," by Frank B. Gilbreth, has just been published, after years of private use on Mr. Gilbreth's contract work. Read the advertisement of the book elsewhere in this issue.

tion of a number of railway maps, railway time-tables and advertisements of firms and corporations, reproduced from the "Guide" of 1857. The first map shows the railways of the country as they stood 50 years ago, with only a few short lines extending beyond the Mississippi River. A brief description of American railway guides is included. A time-table between New York and Chicago indicated three changes of cars in 1857. Two trains daily were scheduled by the Michigan Central route, one leaving New York at 6 a. m. and arriving at Chicago at 5 p. m. of the following day (36 hours), the other leaving New York at 12 noon and arriving in Chicago at 6.40 a. m. of the second day (nearly 44 hours). A few engravings of old hotels are reproduced in this number.

Exercises in Strength of Materials.

PROBLEMS IN STRENGTH OF MATERIALS.—By William Kent Shepard, Ph. D., Instructor of Mechanics in the Sheffield Scientific School of Yale University. Boston and New York: Ginn & Co. Cloth; 6 x 9½ ins.; pp. 70; illustrated. $1.25; mail, $1.30.

A collection of nearly 600 specific problems or exercises in the strength of materials, as here given, promises to be of general usefulness. In fact, many branches of study would be well served by a good compendium of numerical problems, problems so selected as to have constant intimate relation with actual requirements of practical application. Even the pure mathematics courses which engineering students must go through are far too scantily provided with practical problems, in spite of the endeavor of each new text-book writer to insert in his work an abundance of numerical examples for exercising the student in the application of the text.

A text-book, of course, is the more natural place for the presentation of problems, since the principles and methods employed for their solution are then near at hand. In a separate collection such as this, where the student must take the theory and the general method of solution from other sources many special points of difficulty or of variation will occur which call for special explanation or else are lost on the student. Such special explanations are easily provided in a text-book. In a separate collection of problems it is more difficult to interject them, without appearing to make this really subsidiary matter the primary purpose of the book. Perhaps for this reason the present book confines itself strictly to the statement of problems, and with one exception, eight pages on the design of riveted joints, avoids explanatory interjections. This may lead to erroneous conceptions on the part of the student. Thus, in a series of problems it is required to "Determine the position of the neutral axis and the moments of inertia in respect to this axis" for various beam sections. Nothing is said here to indicate that the neutral axis has a different position for every bending-plane, and the student must assume that the moments of inertia around the customary rectangular axes are required. The series of sections in question includes several which are not symmetrical about either of these rectangular axes, and if the bending moment is, for example, in a vertical or horizontal plane, the neutral axis with respect to this moment will have an angular position, so that the moment of inertia computed about a horizontal or vertical axis is not the proper one for the bending calculations. This whole subject, not detailed in most text-books, might properly be given three or four pages of explanation, or at the very least a cautionary foot-note with a reference to an analysis of the case. In the absence of either explanation or cautionary reference, the student is likely to go astray, even when the book is being administered by a teacher.

Regardless of this, however, we welcome the appearance of such a collection of problems. As already said, such collections might profitably be drawn up for several other branches of technical study. We would emphasize the importance of giving the most practical problems that can be found. For example, instead of asking the student to determine the safe load for "a fixed-end timber column" of given dimensions, it might be more useful to describe a specific trestle-post, and ask the question what load this post will carry. The ability to see and analyze practically useful applications of theory cannot be too early or too much insisted upon.

HEALTH EDUCATION SERIES.—Nos. 1 to 13. Boston, Mass.: The Health-Education League. (Rev. George H. Cate, Secy., 113 Devonshire St.) Paper; 3¼ x 5¾ ins. Prices ranging from 2 to 8 cts. each, and from $1 to $5 per 100.

A campaign of popular education is essential to bring home to the people the fact that boards of health can do only a relatively small part of the work that is necessary to protect the public and the individual from dirt, foul air and infectious diseases. The Health-Education League, which includes among its directors Mrs. Helen H. Richards and Prof. C.-E. A. Winslow, of the Massachusetts Institute of Technology, is issuing small pamphlets and providing free lectures on health topics. Among the 13 pamphlets thus far issued, we may mention: No. 1, "Hints for Health in Hot Weather;" No. 2, "Milk;" No. 5, "Healthful Homes;" No. 9, "The Plague of Mosquitoes and Flies;" No. 12, "Emergencies;" No. 13, "Microbes Good and Bad." Other pamphlets deal with "colds," "foods and stimulants," "the care of children," etc. As is to be expected, the treatment of the various subjects is simple and for the most part elementary, but every one of the pamphlets deserves circulation and reading in nearly every household. The pamphlet on "Emergencies" (No. 12), and also a brief unnumbered pamphlet entitled "Health in Mining Camps," contain much information of special value to the engineer and contractor, and might well be bought and distributed in large numbers at the special prices offered.

10,000 MEN

Ten thousand contractors and engineers have bought one book, and a very great percentage have subscribed for the paper edited by the author of that book. We refer to Gillette's "Handbook of Cost Data," and to "Engineering-Contracting," the latter being a weekly periodical for civil engineers and contractors. The "Handbook of Cost Data" has broken all records for the sale of an engineering book, because it is full of detailed costs of all kinds of actual construction. The handbook contains 622 pages, bound in leather, and its price is $4 net, postpaid. "Engineering-Contracting" is $2 a year (52 copies), but for a short time $1 will be accepted for a full year's subscription.

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A Few German Books.

ZAHLENBEISPIELE ZUR STATISCHEN BERECHNUNG VON BRUECKEN UND DAECHERN.—Prepared by Robert Otzen, Assistant at the Hannover Technical College, after the First Edition of F. Grages, Edited by G. Barkhausen, Professor at the Hannover Technical College. Second edition, revised and enlarged. Wiesbaden, Germany: C. W. Kreidel. Paper; 7¼ × 11 ins.; pp. 344; 3 plates and 329 text illustrations. 12 marks; American price, $4.80.

Courses in bridge-design are nowadays included in the structural engineering instruction at nearly every technical college. To work out a complete structure from the first data and assumptions to the ultimate details is the most positive means for fixing in the mind the principles of construction and the reasons and methods for applying them. Text-books for such design courses, books containing details of specimen designs, are not plentiful, however, and the present German work is therefore of some interest. Their utility, or advisability, as compared with personal instruction, seems open to question. It is hardly possible to cover in such a book all or even a large part of the problems which come before the steel designer, so that its functions must be restricted to the presentation of a small number of designs serving as suggestions of the proper order of procedure for those cases and the degree of thoroughness applicable to the analysis of its different members or details. A book of this kind therefore reaches its greatest value when it is planned to give not merely the necessary steps and customary methods, but also the possible variations in method, and the investigation of actions or possibilities which ordinarily may be neglected. The present work is less ambitious, and restricts itself quite closely to the commercially customary procedures. Ten designs are computed and detailed, ranging from simple roof-trusses, plate-girder and riveted truss bridges to arch bridges and roof arches. As a picture of German practice in the design of steelwork these designs are of interest to the American engineer. He will, however, hardly find much in the way of advanced practice, as compared with that customary here. The plan of providing transverse stiffening in compression members by means of batten-plates will, in fact, impress him as an anachronism. The endeavor to calculate the number and position of these battens (in a very unsatisfactory way) is almost humorous.

RATIONELLE KONSTRUKTION UND WIRKUNGSWEISE DES DRUCKLUFT-WASSERHEBERS FUER TIEFBRUNNEN.—By Alexander Perényi, Chief Engineer of the Royal Hungarian State Railways. Wiesbaden, Germany: C. W. Kreidel. Paper; 7¼ × 10¾ ins.; pp. 52; 14 illustrations in the text. 2.40 marks; American price, 96 cts.

Hydraulic problems of the kind arising in engineering work are generally not so simple and definite that they can be attacked by pure theory based on ideal assumptions. Most of them, rather, require to be investigated by experiment before any theorizing is attempted. Mathematical analysis is successful only after full experiments have indicated the chief variables of the problem, traced the typical course of their variation, and furnished values for the several constants affecting the operation. This is true more particularly in those cases where disturbed flow takes place, or we might say where there is a discontinuity in the succession of physical events. One would assume therefore that the air-lift, or (as Mr. Perényi expresses it more precisely the compressed-air water-lift), should pre-eminently stand in need of thorough experimental study before the attempt is made to establish theoretical formulas. The author of the above pamphlet must be credited with much boldness in reversing the order of procedure, by setting up a theoretical study without any basis of experiment whatever. The success of his attempt is questionable. He has undoubtedly expressed numerous sound ideas in the course of his work, but these are not essentially dependent on his mathematical developments. The latter is essentially based on methods of procedure applicable to steady-flow problems, and in the conditions of multiple disturbance which prevail in the air-lift it can hardly claim to be applicable except as its results may be shown to agree with test experience. No experiments or practical verifications are reported in the pamphlet.

LEHRBUCH DER HYDRODYNAMIK.—By Horace Lamb, Professor of Mathematics in Victoria University, Manchester. Authorized German Edition (after the Third English Edition), by Dr. Phil. Johannes Friedel. Leipzig and Berlin, Germany: B. G. Teubner. Cloth; 6 × 9 ins.; pp. 787; 70 illustrations in the text. 20 marks; American price, $8.

The excellent translations of English and French technical works which appear in the German literary field at frequent intervals represent a recognition of the fact that a progressive nation must keep in close touch with the best of foreign work. A similar appreciation in America would be highly desirable. Numbers of works in French and German [even counting the product of the most recent years, only] merit being set before the American reader—who on the whole reads those languages with difficulty, and with but incomplete understanding. Every civilized country is backward in one or more branches of study or investigation, and must look to the literature of other countries for most advanced instruction. England, excelling in many phases of mathematical physics, has produced a series of works which are authoritative in their excellence. Lamb's "Hydrodynamics" is one of these, although originally written a score of years ago (as were indeed a number of other English treatises that still retain their pre-eminence). German students appreciated this work long ago, as shown by its translation into German in 1884 (by R. Reiff). Since then two other English editions appeared, the third (1906) being a thorough revision. This last edition has been translated by Mr. J. Friedel. The way in which he has done his work is worthy of the original, and the publisher's share in the work, the production of an excellent piece of bookmaking, is correspondingly good.

BETON-KALENDER 1908.—Published by the Journal "Beton und Eisen," with the Cooperation of Prominent Technical Men. Third annual appearance. In two parts. Berlin, Germany: Wilhelm Ernst & Son. Part I. in cloth, Part II. in paper; 4 × 6½ ins.; pp. 328 + 468; 950 illustrations in the text and 1 plate. 4 marks; American price, $1.60.

This publication maintains the arrangement and character of the previous yearly issues. Most of the chapters have been revised, however, and there is a general improvement throughout the work, in elimination of crudenesses and better coordination of the various chapters (written by separate authors). As in the last annual issue, the first volume contains general information, less than half of which relates directly to concrete, while the second volume treats of the several fields of application of concrete (mainly reinforced concrete), giving descriptions of structures actually built and of type forms, together with the main elements of computation.

HILFSMITTEL FUER EISENBETON-BERECHNUNGEN.—By Ad. Jöhrens. Wiesbaden, Germany: C. W. Kreidel. Paper; 10¾ × 14¼ ins.; pp. 29; 11 plates and 22 text illustrations. 4.60 marks; American price, $1.84.

Tables and diagrams calculated for $E_s/E_c = 15$ and rectilinear stress-variation are here given.

NATIONAL ASSOCIATION OF CEMENT USERS.—Proceedings of the Third Annual Convention, Held at Chicago, Ill., Jan. 7-12, 1907. Vol. III. Edited by the President. Philadelphia, Pa.: The Association. (Richard L. Humphrey, Pres., Harrison Building). Paper; 6 × 9 ins.; pp. 384; illustrated.

The meetings of this association, founded within the last three years by men practically engaged in concrete construction, have probably contained more solid matter concerning the actual practices of concrete work than can be found in the discussions of any of the numerous societies which take up concrete as an occasional subject. In fact, the material presented in the above-noted book was so interesting that for the most part it was reproduced at the time of the convention in the technical press. In a collected form, the papers make a valuable addition to concrete literature, covering discussions on cement sidewalks, forming and falsework, concrete blocks, the laws of proportioning concrete, the artistic treatment of concrete, and an extensive symposium on waterproofing.

906 Pages of Concrete Data

The most recent and, by all odds, the most complete treatise on the subject of concrete and reinforced concrete contains 906 pages and 715 illustrations and drawings. This treatise has 108 pages on reinforced concrete buildings alone, exclusive of the chapter on the design of columns, beams, etc. It contains 50 pages on reinforced concrete sewers, conduits and pipes. It contains 90 pages on concrete bridges, exclusive of the chapter on bridge piers and abutments. In short, Reid's "Concrete and Reinforced Concrete Construction" is the one book that no concrete engineer or contractor can afford to be without. In spite of the great cost of producing this book, its price is only $5 net, postpaid.

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MASONRY CONSTRUCTION.—A Guide to Approved American Practice in the Selection of Building Stone, Brick, Cement, and Other Masonry Materials and in All Branches of the Art of Masonry Construction. By Alfred E. Phillips, Ph.D., Professor of Civil Engineering, Armour Institute of Technology, and Austin T Byrne, Author of "Highway Construction," "Materials and Workmanship." Chicago, Ill.: American School of Correspondence. Cloth; 6½ × 9¾ ins.; pp. 128; plates and text illustrations. $1.

As an elementary treatise on masonry construction, of a nature sufficiently simple to be intelligible to the home student and yet broad enough to be of value, this book is all that is claimed for it in its rather ambitious title. The experience of its authors, both in book writing and in actual construction, ensures correct and well-arranged information, but it is information that has been written down to the primary student in the art of building—and very properly so.

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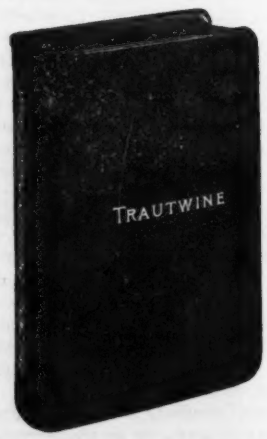

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Wegmann's Dams Revised.

THE DESIGN AND CONSTRUCTION OF DAMS.—Including Masonry, Earth, Rock-fill, Timber and Steel Structures, also the Principal Types of Movable Dams. By Edward Wegmann, M. Am. Soc. C. E., Author of "The Water-Supply of the City of New York, 1658-1895." Fifth Edition, revised and enlarged. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 9 × 12 ins.; pp. 421; 134 plates, 120 text illustrations and 25 tables. $6 net; English price, 21s. net.

Considering the difficulties of the task, Mr. Wegmann appears to have given his well-known monograph on dams a thorough and satisfactory revision. The original book, as some of our readers will remember, was published in 1888, under the title "The Design and Construction of Masonry Dams." In subsequent revisions the scope of the work has been enlarged to include earth, rock-fill, timber and steel dams, and also to embrace the various types of movable dams. The present revision has enlarged the work by no less than 93 pages of reading matter, 39 plates and 45 text figures.

The introduction, which outlines the history of the design of masonry dams, has been extended in the present edition to include a brief abstract of a paper entitled "Some Disregarded Points in the Stability of Masonry Dams," by Prof. L. W. Atcherley and Prof. Karl Pearson, both of University College, London. This paper was published in 1904, and, as some of our readers will remember, set up, among other things, the theory that "a dam collapses first by the tension on the vertical sections of the toe."

The author states that he has entirely rewritten his chapter on the construction of masonry dams; that he has added descriptions of all recent important dams built or under construction, of which he could find record; and that he has added matter on steel, reinforced-concrete, high earth and rolling dams, and also on Stoney sluice-gates. The chapter on reinforced-concrete dams is confined almost wholly to the hollow type of such structures, built by one company. Only one other dam with reinforcement (the Lower Otay, in California) is mentioned. We should have supposed that by this time reinforced concrete would have been used in other dams worth noting, but we must confess that we are unable to cite any such at present. We have not, however, made a search with that end in view. It may be said in passing that it would be surprising if some of the engineers who have had a leaning toward the arch masonry dams, of other than gravity section, should not soon try their hand at the reinforcement of such structures.

In the case of a new edition of a book of such high standing and extended use as the present one neither a detailed nor a critical review is needed. The descriptions of structures alone, with their many plate and other illustrations, are well worth the price of the volume to any one who is called upon to design an important dam. It may be added, for the benefit of those who are not owners of the previous editions, that in the section devoted to masonry dams the descriptions of actual structures are grouped by countries. Mention should be made, in closing, of the quite extensive and very useful bibliography given in the volume, and also of the index; the latter might perhaps have been more detailed, with profit to the user of the book, but within its present limits of length it certainly has the appearance of being very serviceable.

A TREATISE ON THE LAW OF MUNICIPAL ORDINANCES.—By Eugene McQuillin, of the St. Louis Bar. Chicago, Ill.: Callaghan & Co. Leather; 6 × 9½ ins.; pp. clxxxv. + 1,031. $6.

Many city engineers find it necessary to take a hand in drawing municipal ordinances, and all such officials will find it greatly to their advantage to be well posted on both how to do and how not to do it. In addition, a great variety of other information relating to the framing and interpretation of municipal ordinances, and how best to meet the test of their validity, is essential to the work of the municipal engineer. This volume contains as much information on these and related topics as one could expect to find between any two covers.

The author first takes up the nature and requisites of municipal ordinances, the powers of

FIELD SYSTEM

By FRANK B. GILBRETH

WHO THE AUTHOR IS. Frank B. Gilbreth is the contractor who has made the "cost-plus-a-fixed-sum-contract" famous. In order to handle contract work scattered all over North America, Mr. Gilbreth found it necessary to develop a system whereby his foremen would execute work properly, promptly and economically. The code of rules and instructions to his foremen, and the printed forms for their reports, were bound in book form, and this book Mr. Gilbreth called his "Field System." Mr. Gilbreth's contracts have covered the widest possible range. Railways, canals, dams, factories, office buildings, whole industrial towns, are among the works that he has executed.

WHY ENGINEERS SHOULD STUDY "FIELD SYSTEM." Every engineer should know how to manage men, for, whether he confines himself to purely professional work or enters into business of executing construction work, his ambition should be to direct the men under him in a manner that will secure the greatest possible efficiency. A revolution in the art of managing men is now in progress. Direct personal supervision was once deemed essential. Today, however, "system" is fast supplanting personal supervision. By "system" we mean printed or written directions for employees to follow, and daily reports that show what the employees have done. System of this sort has recently been extended to the field survey work of the U. S. Geological Survey. While Gilbreth's "Field System" is not a system for the management of surveys, for example, it is rich in suggestions that can be applied in the management of any kind of field work, whether employees are engaged in surveying or in construction. Its rules and methods are applicable to office work, in so far as the principles involved are concerned. The book, in brief, is a treatise on the science of managing men by system. No engineer who aims to be more than a subordinate can afford not to have this treatise, written by a man who is an acknowledged adept in managing men.

Hundreds of engineers have gone into the contracting business during the past few years, and there is room for thousands more. But if they are to succeed in any great measure, it must be by the intelligent application of system and cost analysis. Gilbreth's "Field System" does not cover the whole field, nor was it written to cover it, but it does cover a very important part of the field, and a part upon which practically nothing has ever been written.

WHY CONTRACTORS SHOULD HAVE "FIELD SYSTEM." Mr. Gilbreth has done in contracting what Mr. Douglas and Mr. Marshall Field have done in the mercantile field. He has taken a class of work involving endless detail, and has reduced the handling of these details to a system by virtue of which economy in construction and celerity in performance are secured, regardless of place or men. Every one has heard the expression, "one-shovel contractor," meaning a contractor capable of managing only one steam shovel at a time. The "one-shovel contractor" is the antithesis of the contractor having a system. The "one-shovel contractor" receives daily reports, it is true, but his reporters are his two eyes. The "one-shovel contractor" has a code of instructions for his men, it is true, but his ready tongue is the only leaf of a code bound between the cover of two jaws. The day of the "one-shovel contractor" is not yet gone entirely, but it will pass rapidly away. Every contractor should have a field system of his own, embodying his own experiences and covering his own necessities, but in the developing of such a field system no contractor can afford not to study the work of Mr. Gilbreth.

COPIES OF "FIELD SYSTEM" STOLEN. When it became generally known that Mr. Gilbreth had supplied his foremen and superintendents with printed instructions, copies of the book were bribed from his employees, and photographed page by page, from cover to cover. Other copies were "lost." and thus made way with entirely. Huge salaries were used to hire away Mr. Gilbreth's superintendents, for the purpose of getting not only their trained services, but for their knowledge of the contents of the "Field System."

MAKING THE BOOK PUBLIC. Mr. Gilbreth's action in making public his "Field System" in its entirety is without precedent in the world of business. It is an act that puts contracting on the high professional level of civil engineering. The civil engineer discloses his method of designing a structure, his purpose being to assist other engineers in doing as well. In the interest of scientific advancement the engineer places on record what he has found to be economic or effective. In the same spirit—we may call it the modern American spirit—Mr. Gilbreth has permitted publication of his private code of instructions to his men—his "Field System." He believes that contractors, and, indeed, all professional business men, will become far more efficient as managers of men if such systems as this are disclosed. He believes that in the general rise of efficiency that will occur all those engaged in business will share. He believes that those who are best fitted to be leaders will remain leaders. Character, experience and ability will have the same relative weight as ever. In these beliefs every broad-minded man ought to concur.

China is a nation that worships "trade secrets." It is a nation of industrial mutes. Their arts and their manufactures are taught by father to son, and zealously guarded. There has been no pyramiding of improvements upon one original invention as a base. The Chinese do not lack inventive ability. They are merely cursed by the curse of secretiveness. Their industries are plastered with signs of "No admittance," and are mummified in consequence. In striking contrast with the Chinese method is the American method. Our doctors, our engineers and our men of science generally have never concealed their discoveries or their improvements. Latterly our business men have shown a recognition of the truth of the general proposition that it pays the individual to share his discoveries with the rest of his fellows. Such generosity, in the final analysis, is simply an enlightened selfishness. The publishers of Gilbreth's "Field System" urgently request other contractors and business men to come forward with their systems and put them permanently on record. Let business men generally adopt the altruistic policy that actuates professional men, and in its prosperity America will soon rise as far above its present level as it now stands above the level of the Chinese Empire.

PRICE OF THE "FIELD SYSTEM." The book has nearly 200 pages, bound in leather, and its price is $3 net, postpaid. Order now, before the edition is exhausted.

The Myron C. Clark Publishing Co.
357 Dearborn Street, Chicago

municipal corporations to pass such ordinances, methods of enactment, penalty clauses, questions of reasonableness, amendments and repeal, and constitutional questions. The author discusses in detail ordinances relating to taxation, to municipal police powers (including public health and public safety), to public improvements, and finally, ordinances involving the granting of franchises. Numerous footnotes are used for the citation of cases, and a usable index is provided.

If the volume promises to be useful to engineers, as we have pointed out and believe, it certainly will be many times more useful, and in fact we should suppose indispensable, to city attorneys and to lawyers in general engaged in municipal practice.

Wireless Telegraphy.

A HANDBOOK OF WIRELESS TELEGRAPHY.—Its Theory and Practice. For the Use of Electrical Engineers, Students and Operators. By James Erskine-Murray, D. Sc., M. Inst. E. E. New York: D. Van Nostrand Co. London, England: Crosby Lockwood & Son. Cloth; 5½ x 8¾ ins.; pp. 322; 131 illustrations, mostly in the text, and 11 tables. $3.50, net.

The author has arranged what may be fairly considered a most thorough general treatise of wireless telegraphy, and one bringing together the latest knowledge and theories. Transactions of engineering societies, technical journals and previous works have been freely drawn from, though always to good purpose and with proper acknowledgment. The material easily falls into 21 chapter divisions each of which treats some distinct phase of the art and science. Not all of these chapters can be considered co-ordinate in value and a slight general knowledge of wireless telegraphy is premised for understanding the prospective in which this arrangement of material should be considered. As the work is in no sense "popular" such an arrangement would seem permissible. Two chapters are largely historical and general, eight treat collectively methods and apparatus of various systems and eight are devoted to specific systems now in more or less practical use. The remaining chapters deal with the theories of transmission, of very high frequency apparatus and with some practical matters of adjustments, manipulation, etc.

In the first chapter the author broadly outlines the relation between all electric telegraphs, both wire and wireless. As one extreme type of the first, the familiar Morse system is taken with its closed circuit consisting of a single wire and the earth return. Here the whole current, except for unavoidable and unintentional leakage, passes through both transmitter and receiver. The other extreme type is taken as one of Sir Oliver Lodge's systems (one not in general or extended use) which depends purely on the magnetic induction through two closed circuits, one of these being at the transmitting station and the other at the receiving. No current passes from transmitting to receiving apparatus, and the signals are given by changes in magnetic induction.

Between these two extreme types the author has grouped all the others, including those that are now the most successful and practical. In these, alternating-current waves of exceedingly great frequency pass from the transmitting to the receiving station through the upper layer of the earth's surface, accompanied by lines of force from the aerial system. The bulk of the book treats the theory and practice of all the practical systems now in use. Even the design of apparatus connected with them is considered at some length with no little mathematical treatment. It should be noted that the author has made mathematical analyses, in many cases, of available experimental data on the operation of wireless telegraph equipments and has thus made many interesting deductions.

The main principles of operation and features of apparatus of the Marconi, Lodge-Muirhead, Fessenden, Hosier-Brown, Wildman (U. S. Signal Corps), De Forest, Poulsen, Slaby-Braun and Tesla systems, as in practical operation up to and including the present year, are outlined, one chapter being devoted to each system.

The book should prove useful to persons more than superficially interested in modern telegraphy. The book is not intended in any sense as popular, hence the technical treatment and mathematical discussions will not appeal to persons desiring a non-technical exposition, of which there are already plenty.

BULLETINS, OFFICE OF EXPERIMENT STATIONS.—A. C. True, Director. Washington, D. C.: Pub. Doc. Paper; 5¾ x 9 ins.

No. 181: Mechanical Tests of Pumping Plants in California. By J. N. LeConte and C. E. Tait. (Work done in cooperation between the Irrigation and Drainage Investigations of the Office of Experiment Stations and the State of California.) Pp. 72; ten text illustrations and four folding tables.

No. 188: Irrigation in the Yakima Valley, Washington. By S. O. Jayne, Irrigation Manager, Irrigation and Drainage Investigations, Office of Experiment Stations. Pp. 89; two plates and four text illustrations.

No. 190: Irrigation in Northern Italy.—Part II. By Elwood Mead, Chief of Irrigation Investigations. Washington, D. C.: Pub. Doc. Paper; 5¾ x 9 ins.; pp. 86; four plates and two text figures.

No. 191: Tests of Internal Combustion Engines on Alcohol Fuel.—By Charles Edward Lucke, M. S., Ph. D., Assistant Professor of Mechanical Engineering, Columbia University, and S. M. Woodward, M. S., M. A., Irrigation Engineer, Office of Experiment Stations. Washington, D. C.: Pub. Doc. Paper; 5¾ x 9 ins.; pp. 89; 20 plates and 13 text illustrations.

As a continuation of a previous bulletin (158), there is given in the first of the bulletins listed above the results of a considerable number of field tests of pumping plants using gasoline, electricity and steam. These results are given separately for each plant, combined with descriptive text, and they are also summarized for comparative purposes in tabulated form. Introductory to the tests data are some useful and interesting paragraphs on the measurement of fuel, power, lift, water lifted, and feed-water. This and the preceding bulletin add very largely to the hitherto meager data on small pumping plants. The information given on the tests includes the diameter and depth of the well in which the water is lifted, descriptions of the engine and pump, figures for discharge, lift and useful horse-power, amount and cost of gasoline or electricity used, and cost per acre-foot of water lifted one foot, and also actual cost per acre-foot of water pumped.

Bulletin 188 describes in considerable detail the irrigation works of the Yakima Valley, together with methods of distributing the water, preparing and seeding land for irrigation, and the actual application of the water to the crops. The various crops raised are also discussed separately, and facts and figures are given regarding the cost of water per acre and particularly regarding the duty of water. Seepage loses are also taken up.

This belated continuation of Mr. Mead's investigation in Italy in 1903, comprising Bulletin 190, deals with the section watered by the Adda and Adige rivers, and takes up especially the legal and institutional phases of irrigation, describing the operation of canals controlled by the Government and those controlled by cooperative asrociations of water users.

The history and present status of the irrigation laws of Italy is given with some comparisons with American conditions.

In the opening part of Bulletin 191 it is stated that:

The objects of this investigation may be put under two heads: First, to determine whether the gasoline and kerosene engines at present on the American market can run on alcohol as a fuel; second, to determine the improvements which might be desirable in the design of engines manufactured especially for alcohol fuel.

The results of 192 consumption tests on eight engines of various horse-power are presented in considerable detail in this bulletin. It was found that not only could any ordinary gasolene engine be run on alcohol fuel without material change in construction, but also that its operation is rendered less noisy, that its maximum power may be materially increased and that there is no danger of injurious hammering. It was found that fuel consumption was affected by the time of ignition, by speed and by initial compression of the charge. An early ignition and high speed considerably bettered the consumption, while increasing the compression only slightly improved it. The changes in design advisable for engines intended to work solely on alcohol, are minor and may be inferred from remarks scattered through the pamphlet. Such recommendations have not been collected or summarized.

With any good small stationary engine as low a figure as 0.70-lb. gasolene or 1.16 lbs. alcohol, corresponding to 0.118 and 0.170-gal., respectively,

IN PREPARATION
READY AT AN EARLY DATE

Economics of Railway Operation

By M. L. BYERS
Chief Engineer, Maintenance-of-Way, Missouri Pacific Railway.

A Necessary Book for Every Person Engaged in Railway Work

THE GENERAL OBJECTS OF THE "ECONOMICS OF RAILWAY OPERATION" ARE:

(1) **To so outline the operations of each department** as to give to those not familiar with its workings a sufficient insight to enable them readily to acquire further detailed information through their own observations, and through their ability to inquire intelligently in regard to those features which they do not understand.

(2) **To bring into clear relief the underlying principles of economic operation** with a view to the practical usefulness of this information to the employee in securing better results in that portion of the field under his direction; also to give him a clearer general understanding of the science of railroading, and so fit him for further promotion. In order to make the information available to as many as possible ,the use of mathematics and technicalities has been avoided to the utmost.

SYNOPSIS OF CONTENTS

PART I.—ORGANIZATION:
A general discussion of the principles of organization and the objects to be achieved thereby. The difference between Divisional and Departmental Organization is indicated, together with the relative advantages and disadvantages of each. An ideal organization (based very largely on that of the Pennsylvania Railroad) stating in considerable detail the duties of the principal positions on a railroad is given.

PART II.—EMPLOYMENT, EDUCATION AND DISCIPLINE OF FORCES:
Statistics showing the number of railroad employees of the different classes in the United States, information in regard to employees' Relief Associations, Railway Relief Departments, Railway Savings and Insurance Departments, and other means for caring for the interests of the employees are shown. The subject of education and discipline of employees is discussed with a view to illustrating the underlying principles and the objects to be attained.

PART III.—ACCOUNTS AND ACCOUNTING:
The objects of accounting and the theory underlying the proper subdivision of earnings and expenses for different purposes are explained. An ideal subdivision of earnings, expense, material, and other accounts is outlined, the reasons for the subdivision being briefly stated.

PART IV.—REPORTS:
A list of the principal operating reports, together with a brief description of the purpose of each, is given; some of the more important forms are illustrated in Part V.

PART V.—ECONOMIC OPERATION:
Contains a brief outline of the general operations of each of the Departments of the Railroad, and the endeavor is made to bring clearly into relief the principles underlying economic operation and to call attention to the directions in which economies are to be secured. Shows the different branches of railway construction, operation and maintenance in their relative dimensions and relations to each other, thus making it possible for the reader to obtain a clear idea of the general subject and of the general principles involved. Certain subjects are treated in considerable detail, with the particular view of indicating how the general subjects can be amplified by special study.

PART VI.—ANALYTICAL:
The increase in size of the railway system has made it impossible for the General Officer to obtain by personal inspection the information needed by him in keeping in touch with the operations under his charge, and this condition has necessitated the securing of various reports to supplement his observation; the endeavor is made to illustrate the method of using these reports and the principles upon which their arrangement must be based. Incidentally, the illustrations convey considerable information in regard to Railway Operations.

PART VII.—BETTERMENTS:
The constant growth of population carries with it the necessity for similar increase of transportation facilities; the various classes of facilities are indicated, together with the general principles to be observed in their design and the effects that may be looked for as a result of their enlargement.

This work will be found of inestimable value by all classes of railway employees, Railway Officers, Attorneys and engineering students, as well as by general readers interested in railway operations.

Buckram; 6 × 9 inches; about 700 pages; many figures, diagrams and forms illustrating the best recent practice. Price, $5.00, net.

The Engineering News Book Department
220 Broadway, New York City

may be expected. These consumptions represent thermal efficiencies of 18.5% for gasolene and 20.7% for alcohol, on a basis of the low calorific values obtained.

The Sanitary Evolution of London.

THE SANITARY EVOLUTION OF LONDON.—By Henry Jephson, L. C. C. Brooklyn; N. Y.: A. Wessels Co. Cloth; 5½ × 9 ins.; pp. 440. $1.80, net.

Mr. Jephson dedicates his book to the London County Council, of which he is a member. He writes from the viewpoint of the intelligent, studious, earnest member of such a body, rather than from that of a sanitarian.

The author first reviews at some length certain phases of public health matters in London, up to the early '50's. After continuing his story for the five years ending with 1860, he makes the accurate population figures provided by the decennial censuses a reason for dividing the remainder of the book into chapters covering ten years each and into a final chapter for the five years ending with 1906.

The volume is chiefly a review of sanitary legislation (by Parliament) and of extracts from reports of various local and general medical officers of health, combined with statements drawn from various committees appointed to investigate sanitary matters in the metropolis. Its principal statistics relate to population, death rates and overcrowding. Such accounts of sanitary works as are given consist of broad outlines of the main sewerage and sewage disposal system of London, the gradual provision of filtered water, and various housing improvements. The private water companies that supplied London up to a few years ago are represented as a long-continued evil, happily terminated by a change to public ownership, which change, unhappily the author thinks, vested the control of these great works in a body chosen by the various local governments, etc., instead of in a thoroughly representative elected body (like the London County Council). Not many decades ago, the author cites against the private water companies, some districts had water only one hour to one-fourth hour per day, and none at all on Sundays. Filtration, the author states, was forced on the companies in the early '50's, but for many years afterwards he asserts that the companies did not always furnish filtered water.

The creation of the London County Council in 1888, and the consolidation of the many petty local governing areas some ten years later into 27 boroughs (in addition to the cities of London and Westminster), have done much towards bringing sanitary order out of insanitary chaos, centralizing responsibility and providing the necessary machinery for enforcing sanitary legislation. Greater centralization of control over sanitary matters, the author believes, is still needed, and in closing he strongly urges the need for more comprehensive measures for use in dealing with the housing question.

The book is valuable as an outline of the sanitary legislation affecting Greater London, and as an abstract of reports of health officers and others during a number of decades past. The abstracts are rather tedious on account of their going over and over again the same general ground for each period covered. The book would have gained, both in interest and in force, if the author had put more of his information in his own language, had used smaller type for such quotations as he employed, and had grouped or classified his discussion more thoroughly.

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by mental gymnastics and learn real rapid calculation by a book of "Products or Dividends." Beats any means or machine. Examples: 46,656 × 89 = 4,152,384. And 1,496,904 ÷ 15.432 = 97,000. It figures anything EXACT and quick as a wink without previous effort or remaining doubt. Extract from the Prospectus and Instructor: "This is a very simple book, but an extremely useful one for it does away entirely with multiplication and division. One has but to learn its logical arrangement and to apply the most elementary arithmetic to become at once an adept computer. It takes a great deal of time to multiply and divide and it is tedious, hard mental work too, but worse than anything else are the errors that are unavoidably made. There is always some doubt at best, and to be only reasonably sure of correct work it takes double time and labor. Without the usual loss of time or labor this book gives absolutely correct results. There is no doubting, or puzzling, or laborious checking, results are infallible. . . . The steps of taking out a result are identical for every case of multiplication or division, respectively, regardless of the numbers used. Nothing more than locating results and fixing the decimal point are required to master this book. . . . of inestimable service for the quick and accurate solution of cumbersome problems in mensuration. . . . Actual use is the test that reveals the true worth of this book." There are 4,000 Instructors in use to-day. Price 10c. (It is worth 10x10c., don't fear.) The Calculator "Products or Dividends" costs $5. Address G. A. CHRISTENSEN, Civil Engr., Box 144, Oakland, Cal.

Electrical Power Plants and Power Transmission.

POWER STATIONS AND POWER TRANSMISSION.—A Manual of Approved American Practice in the Construction, Equipment and Management of Electrical Generating Stations, Substations and Transmission Lines, for Power, Lighting, Traction, Electrochemical and Domestic Uses. Part I.: Power Stations. Part II.: Power Transmission. By George C. Shaad, E. E., Assistant Professor of Electrical Engineering, Massachusetts Institute of Technology. Chicago, Ill.: American School of Correspondence. Cloth; 6½ × 9¾ ins.; pp. 74; 10 plates and 41 text illustrations. $1.

This volume seems to be such a text-book as would be recommended for the so-called "concentric methods" of teaching electrical engineering. It will be remembered that the proposer of this scheme would start his students on the practice first and follow with the theory and higher mathematical treatment. The correspondence school methods may be similarly described, although the majority of these students after learning "how" do not seek diligently for the "why" of such steps as are taken. This book seems to have fairly well followed the intentions of the publishers, stated in their preface.

> The aim has been to lay special stress on the practical side of each subject, as distinguished from theoretical or academic discussion. The utmost care has been used to bring the treatment within the range of the common understanding, so that the work will appeal not only to the technically trained expert, but to the beginner and to the self-taught practical man.

It is hard to believe that the "technically trained expert" will use this book as a guide in his designing. He may take steps and accomplish results similar to those indicated in this volume, but such a treatise would seem unnecessary for him—unless he should be subject to some serious lapses of memory.

The volume is divided into two parts, one on the power station itself, and one on transmission. In the first part the factors are briefly stated which enter into the geographical location of the station. Among these factors is a method of finding the centre of electrical distribution by what is really a "center of gravity" method. As long as the author has not attempted to explain the theory of his method it would seem that he might have stated a method involving vertical and horizontal reference axes, which would have been quicker and simpler. Moreover, it would seem as though any reader, self-educated or not, who was seriously studying this manual would have come to know enough about elementary mechanics to understand the use of coordinates, as such.

The steam, hydraulic and electrical equipment, for all classes of plants, is treated by statements of general requirements of good standard practice. One chapter is devoted to buildings, records, operating, etc. Naturally this material has been extremely condensed, and by many will be considered too meager.

In the second part of the book the first eight pages are devoted to the properties of copper and aluminum conductors. Some 14 pages are given up to a discussion of direct and alternating-current local distribution systems, and in about 20 pages are contained notes on the properties and computations of high tension transmission lines. Naturally, in these computations it has been impossible to avoid higher mathematics and the author has had recourse to complex quantities and simplified vector diagrams. The remainder may be considered as elementary instruction on high tension apparatus and line constructions.

As might be expected from the standing of the author, this book is free from those weaknesses of correspondence-school books which have been criticized in these columns. It should be a very acceptable aid to those engineers who are called upon for such a great variety of work that they cannot become specialists in this particular branch.

RAILROAD LOCATION

A College Text Book

No course in civil engineering is complete without a thorough course in railroad location, for the methods used on railroad surveys are applicable to highway surveys, canal surveys, etc. A book that is admirably adapted for use as a text-book, or as a supplement to lectures, is Railroad Location Surveys and Estimates, by F. Lavis, M. Am. Soc. C. E. It has been adopted by several engineering colleges, and is generally conceded to be the clearest exposition of modern field methods yet published. It is written by an engineer of wide experience in railway work. The book contains 270 pages, and its price is $3, net, postpaid.

Myron C. Clark Publishing Co.

357 Dearborn Street, Chicago, Ill.

MAKING A MUNICIPAL BUDGET.—Functional Accounts and Operative Statistics for the Department of Health of Greater New York. New York: Bureau of Municipal Research. Paper; 5¾ × 8¾ ins.; pp. 171. 50 cts.

It is a great pleasure to call attention to what, so far as we know, is the first attempt to apply to an American municipal department the scientific principles of budget making. Of course every municipality employs some method of determining how much money should be made available for the expenses of its several departments, but as a rule these methods are most decidedly of the hit-or-miss type. As a preliminary to much-needed reforms in budget making in New York City, the Bureau of Municipal Research, a private organization, has cooperated with the Board of Estimate and Apportionment and the Department of Health in formulating a budget scheme for the department named. The pamphlet before us explains how this came about, and sets forth the results of a study of the objects of the Health Department, the methods which it is employing to attain those objects, and means of judging the success of the methods. Connected with this exhibit is an outline of a new system of accounting designed to distribute expenditures to different branches of the public health service. The major portion of the pamphlet is devoted to tabular forms for reporting the many and various operations of the New York Health Department, so as to enable both public officials and citizens to judge of the efficiency of the work and the wisdom of the appropriations asked for the various branches of the work when a department submits its estimates of needed funds for an ensuing year to the Board of Estimate and Apportionment.

It is hardly to be expected, we presume, that so voluminous a statistical document as this pamphlet suggests would be presented to the Board of Estimate and Apportionment by every department in the city. But whether or not this is done, it is certainly highly desirable that municipal accounts and statistics should be so kept and should be so reported by the several departments of New York or any other city that any intelligent person can find out the actual uses to which the money raised each year by the tax levy is put, and can also judge how well the money is used. As this pamphlet clearly points out as regards the accounting system of the New York

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Health Department, the bookkeeping of our American cities in general has as its main if not its sole object the setting forth of receipts and disbursements under separate appropriations or funds. That is, it is designed to show whether or not specific appropriations have been overdrawn, what the balances are, and whether any money has been stolen. Under such conditions, it is well-nigh impossible to ascertain what any municipal service really costs.

This pamphlet deserves wide circulation. It is to be hoped that the work outlined will be extended to cover all the municipal departments of New York City, and that a similar plan, by whatever local methods seem most appropriate, will be put into effect throughout the country.

THE DISINFECTION OF SEWAGE EFFLUENTS FOR THE PROTECTION OF PUBLIC WATER SUPPLIES.—By Karl F. Kellerman, Physiologist in Charge of Water Purification Investigations; R. Winthrop Pratt, Chief Engineer of the Ohio State Board of Health, and A. Elliott Kimberly, Special Assistant Engineer of the Ohio State Board of Health and Collaborator of the Bureau of Plant Industry. Bulletin No. 115, Bureau of Plant Industry: B. T. Galloway, Chief of Bureau. Washington, D. C.: Pub. Doc. Paper; 5¾ × 9 ins.; pp. 47; 42 tables.

Interesting studies are here given of the use of copper sulphate and calcium hypochlorite, bleaching-powder or chlorin, for the disinfection of sewage and of the effluents from sewage purification works. The chemicals were applied to actual plants, copper sulphate having been used at two small institutions and at the municipal sewage works at Westerville and Marion, O., and the hypochlorite or chlorin at one of the institutions and also at Marion, O. Details of the nature of the tests, the actual and unit volumes and costs and the bacterial results obtained, are given for each chemical as employed at each plant. Capital charges are not taken into account. The conclusions indicate that "both calcium hypochlorite and copper sulphate have high germicidal values when acting upon partially purified sewage"; that the hypochlorite is more efficient, both as a germicide and as to cost, than the copper sulphate, but is "more disagreeable and less convenient to handle than copper sulphate." The usefulness of the report could have been increased if the cost figures for the several plants had been given per 1,000,000 gals.

AMERICAN WATER-WORKS ASSOCIATION.—Minutes of Proceedings of 27th Annual Convention, Held at Toronto, Ontario, June 17-21, 1907. (J. M. Diven, Secy., 14 George St., Charleston, S. C.) Paper; 6 × 9¼ ins.; pp. 148; illustrated.

Following the practice of some other societies, the business proceedings of the last convention of the American Water Works Association, together with the membership list, have been printed separately. They will be followed by a second volume containing papers and discussions. Committee reports are included in the present number, including a report and discussion on standard specifications for cast-iron pipe.

THE PROGRESS OF ELECTRIC TELEPHERAGE.—By Prof. Emile Guarini. Paris, France: H. Dunod & E. Pinat. Paper; 6¼ × 9¾ ins.; pp. 24; illustrated. 2 francs; American price, 60 cts.

This translation of a French pamphlet is a general description of the possibilities and utilities of the transportation by electricity of material around industrial plants. Although containing numerous illustrations and drawings, they are neither of sufficient detail or clearness to be of any but a pictorial value; in fact, the aparent purpose of the book is to furnish sufficient information regarding the subject to ensure further investigation by interested parties.

SOUVENIRS DE NEUF CONGRES DE NAVIGATION.—By F. B. De Mas. Paris, Franci: Ch. Béranger. Paper; 6⅛ × 10 ins.; pp. 267. 10 francs; $3.

One would hardly think that the nine annual conventions of a society dedicated to the study of navigation could contain enough of the social, as distinguished from the technical, to fill two hundred odd pages with a chatty account of the entertaining features of meetings which, from all American analogies, would seem to be the dryest of affairs. But it seems as of old that "they order this matter better in France." M. de Mas, a retired Inspector-General of the French Routs ot Chaussées, has attended these congresses since the organization of the society, in 1885. He has set down in his book but little of the serious work done at these conventions; that has been left to the official annual reports. With the careful detail of the diarist, however, he has reported all the excursions, the banquets, the teas and receptions that filled out the leisure hours. To those who were with M. de Mas on these trips, the account must recall many pleasant days; to the American reader it is a curious example of racial temperament.

PRACTICAL WRINKLES FOR THE PLUMBER.—A Collection of Valuable and Handy Methods, Devices and Contrivances in Plumbing Work. By R. M. Starbuck, Author of "Modern Plumbing Illustrated," etc. (Hartford, Conn.: R. M. Starbuck & Sons, 284 Asylum St.) Boards; 4¼ × 6¾ ins.; pp. 137; illustrations in the text. $1.

Brief, plainly written, descriptions of how to do many things connected with plumbing work are given in this little book. Some rules, formulas and diagrams are also included. The sketches are to be commended for their simplicity and clearness. The book would doubtless be serviceable to many engineers and contractors having to do with plumbers' and allied work.

EARTHWORK DIAGRAMS.—Giving Graphically the Cubic Contents for Different Heights of Banks and Cuttings, Either 66 Ft. or 10 0Ft. Chains. By R. A. Erskine-Murray and Y. D. Kirton. 36 × 26 ins. London, England: Crosby Lockwood & Son. 5s, net; or mounted on card, 7⅛s., net. American price, $2, net; mounted on card, $3, net.

The size of this chart, 36 × 26 inches, is sufficient to condemn it for general use, even in the office; for field work in camp or in the open, where a preliminary estimate sheet, such as this will be mostly needed, it will be impossible. The flimsy nature of the paper precludes its being rolled or folded, and if mounted on board, it would certainly be a burden in transportation. The chart consists of scales from which may be taken off station yardages, with level ground center heights to the decimal of a foot for arguments and side slopes of 1½ to 1, 1 to 1 and ¼ to 1. There are in print numerous compact tables which will answer the purpose to a much greater advantage.

Publications Received.

BALANCING OF ENGINES.—Steam, Gas and Petrol. An Elementary Text-Book, Using Principally Graphical Methods. For the Use of Students, Draftsmen, Designers, and Buyers of Engines. By Archibald Sharp, Assoc. M. Inst. C. E. London, New York and Bombay: Longmans, Green & Co. Cloth; 5½ × 8¾ ins.; pp. 212; illustrated. $1.75, net.

BOARD OF RAILROAD COMMISSIONERS, IOWA.—Annual Report for the Year Ending June 30, 1906. Des Moines, Ia.: Pub. Doc. Cloth; 5¾ × 8¾ ins.; pp. 410.

BULLETINS, BUREAU OF THE CENSUS.—Census of Manufactures: 1905. S. N. D. North, Director. Washington, D. C.: Pub. Doc. Paper; 9 × 11½ ins.
No. 81: Shipbuilding.
No. 83: Slaughtering and Meat Packing, Manufactured Ice, and Salt.
No. 84: Carriages and Wagons, and the Steam and Street Railroad Car Industry.
No. 86: Copper, Lead and Zinc, Smelting and Refining.
No. 88: Power Employed in Manufactures.

BULLETINS, U. S. GEOLOGICAL SURVEY.—Charles D. Walcott, Director. Washington, D. C.: Pub. Doc. Paper; 5¾ × 9 ins.
No. 277: Mineral Resources of Kenai Peninsula, Alaska. Gold Fields of the Turnagain Arm Region, by Fred H. Moffit. Coal Fields of the Kachemak Bay Region, by Ralph W. Stone. Pp. 80; 18 plates (one in pocket) and 5 text figures.
No. 309: The Santa Clara Valley, Puente Hills and Los Angeles Oil Districts, Southern California. By George Homans Eldridge and Ralph Arnold. Pp. 266; 41 plates (one in pocket) and 17 text figures.
No. 311: The Green Schists and Associated Granites and Porphyries of Rhode Island. By Benjamin K. Emerson and Joseph H. Perry. Pp. 74; two plates and six text figures.

A COURSE IN MATHEMATICS.—For Students of Engineering and Applied Science. By Frederick S. Woods and Frederick H. Bailey, Professors of Mathematics in the Massachusetts Institute of Technology. Vol. I, Algebraic Equations, Functions of One Variable, Analytic Geometry, Differential Calculus. Boston and New York: Ginn & Co. Cloth; 5½ × 8½ ins.; pp. 385; 219 illustrations in the text. $2.25; by mail, $2.40.

THE CURRENTS IN BELLE ISLE STRAIT.—From Investigations of the Tidal and Current Survey in the Seasons of 1894 and 1903. W. Bell Dawson, M. Inst. C. E., Engineer in Charge. Ottawa, Can.: Department of Marine and Fisheries. Paper; 6½ × 9¾ ins.; pp. 43; four folding plates.

ELECTRIC RAILWAYS.—Theoretically and Practically Treated. By Sydney W. Ashe, B. S., E. E., Assoc. M. Am. Inst. E. E., Consulting Electrical Engineer, Department of Electrical Engineering, Polytechnic Institute of Brooklyn. Vol. II. Engineering Preliminaries and Direct-Current Sub-Stations. New York: D. Van Nostrand Co. London, England: Archibald Constable & Co., Ltd. Cloth; 5 × 7¾ ins. 145 illustrations, mostly in the text. $2.50.

HYDRAULICS.—By S. Dunkerley, D. Sc., M. Inst. M. Inst. M. E., Professor of Civil and M... Engineering in the University of Manchester... rector of the Whitworth Laboratories. In T... umes. Vol. I. Hydraulic Machinery. Lon... York and Bombay: Longmans, Green & Co... 5¼ × 8¼ ins.; pp. 343; 209 illustrations in ... $3, net.

ILLINOIS BUREAU OF LABOR STATISTICS... Coal Report, 1906. Also the Eighth Annual ... of the Illinois Free Employment Offices, for ... Ended Sept. 30, 1906. David Ross, Secretary ... field. Springfield, Ill.: Pub. Doc. Cloth; ... 8¾ ins.; pp. 418 + 87.

THE LIFE AND PRESERVATION OF PITCH ... FENCE POSTS.—By B. C. Buffum. Bulletin ... Wyoming Experiment Station, Laramie, Wyo. ... 5¼ × 8½ ins.; pp. 18; seven illustrations in the ...

MAP OF THE PRINCIPAL MINING TOWNS IN THE SOUTHWESTERN PART OF THE STATE OF CHIHUAHUA, MEXICO.—Compiled from Original Notes by H. A. Horsfall, Mining and Mechanical Engineer (69 Wall St., New York). 9 × 12½ ins.

MERCK'S 1907 INDEX.—An Encyclopedia for the Chemist, Pharmacist and Physician. (Third Edition.) New York: Merck & Co. (15 University Place.) Cloth; 6¼ × 9½ ins.; pp. 472. 25 cts. to users of drugs, only.

PRINCIPLES OF REINFORCED CONCRETE CONSTRUCTION.—By F. E. Turneaure, Dean of the College of Engineering, University of Wisconsin, and E. R. Maurer, Professor of Mechanics, University of Wisconsin. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5½ × 9¼ ins.; pp. 317; 130 illustrations, mostly in the text. $3, net.

RECLAMATION OF TIDE LANDS.—By J. O. Wright, Supervising Drainage Engineer, Irrigation and Drainage Investigations, Office of Experiment Stations. (Reprint from Annual Report of the Office of Experiment Stations for the Year Ended June 30, 1906.) Washington, D. C.: Pub. Doc. Paper; 5¾ × 9 ins.; pp. 373 to 397; 5 plates and 6 text figures.

SEWAGE DISPOSAL FOR PITTSBURG.—Report of Special Committee on Municipal Sanitation to the Chamber of Commerce of Pittsburg, Oct. 10, 1907. (Wm. Glyde Wilkins, Chairman Committee.) Paper; 6 × 9 ins.; pp. 30.

SOME REACTIONS DURING WATER TREATMENT.—By Edward Bartow and J. M. Lindgren. (Reprinted from the Journal of the American Chemical Society, Vol. XXIX., No. 9, September, 1907.) Paper; 6¼ × 9¼ ins.; pp. 1293 to 1305; six illustrations in the text.

TRADE AND CUSTOMS AND EXCISE REVENUE OF THE COMMONWEALTH OF AUSTRALIA.—For the Year 1906. Part II. Published under the Authority of the Minister of Home Affairs, by G. H. Knibbs, Commonwealth Statistician. Melbourne, Australia: Pub. Doc. Stiff paper; 8 × 12¾ ins.; pp. 269 to 445.

THE USE OF THE NATIONAL FORESTS.—U. S. Department of Agriculture, Forest Service. Gifford Pinchot, Forester. Washington, D. C.: Pub. Doc. Boards; 5 × 7 ins.; pp. 42; seven plates.

WAGES, HOURS OF LABOR, AND RETAIL PRICES OF FOOD, 1890-1906.—Bulletin of the Bureau of Labor, No. 71, July, 1907. Washington, D. C.: Pub. Doc. Paper; 5¾ × 9 ins.; pp. 408.

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